

# **GRADUATE PROGRAM POLICY**

## **DEPARTMENT OF ANIMAL AND FOOD SCIENCES (ANFS)**

**COLLEGE OF AGRICULTURE AND NATURAL RESOURCES (CANR)**

**UNIVERSITY OF DELAWARE**

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**The Department of Animal and Food Sciences has six core graduate degree offerings:**

**Course-Based Master of Science (M.S.) Degrees**

1. Food Technology,
2. Applied Animal Science,
3. Animal Health

**Thesis and Dissertation-Based Degrees**

4. The Master of Science (M.S.) Degree in Animal Science,
5. The M.S. Degree in Food Science,
6. The Doctor of Philosophy (Ph.D.) Degree in Animal and Food Sciences.

**4+1 Programs.** The Course-Based MS Degrees can also be combined with our undergraduate degrees to generate the following 4+1 Degree Programs:

7. Animal Bioscience / Applied Animal Science (4+1)
8. Animal Bioscience / Animal Health (4+1)
9. Animal Science / Applied Animal Science (4+1)
10. Animal Science / Animal Health (4+1)
11. Pre-Veterinary Medicine / Applied Animal Science (4+1)
12. Pre-Veterinary Medicine / Animal Health (4+1)
13. Food Science / Food Technology (4+1)

The course-based M.S. Degrees are primarily graduate-level course-based degrees, coupled with research or problem-solving project, but do not require a research thesis.

The course-based M.S. Degrees require specific courses, as detailed in section II, below.

The thesis-based M.S. and Ph.D. degrees are earned through an academic research program requiring the completion of an approved thesis or dissertation, respectively.

For the Thesis/Dissertation-requiring degrees, the academic program will be developed jointly by the student and the advisor, with approval of the student's graduate committee.

Other than the core course requirements (see below), there are no specifically required graduate courses

for the thesis/dissertation-requiring M.S. or Ph.D. degrees.

## **I. Admission Requirements for Course-Based MS Degrees, Stand Alone Programs (not 4+1)**

### **A. General Admission Requirements**

Applicants must submit all materials directly to the Graduate College using the online admission process before admission can be considered. Admission applications are available at: <https://grad-admission.udel.edu/apply/>

On a 4.0 system, a G.P.A. of at least 3.0 is preferred. Applications will be evaluated based on a combination of record of academic or professional achievements, 3 letters of recommendations, and a personal statement describing how the completion of the MS degree will contribute to their professional goals. The Graduate Record Examination (GRE) is optional. If included in the application, a combined score (quantitative + verbal sections) of 300 on a scale of 340 on the general exam is desirable. If the GRE is not submitted, applicants must provide other evidence of quantitative ability such as A or B grades in math and advanced chemistry. Any scores submitted voluntarily by an applicant by an applicant will be evaluated holistically but will not be used to determine admission. Students for whom English is not their first language, the minimum scores on the TOEFL and/or IELTS are based on the University of Delaware graduate admission requirements. (<https://www.udel.edu/academics/colleges/grad/prospective-students/grad-admissions/test-scores/>).

Admission to the course-based MS degree programs is based on selections made by the department Graduate Advisory Committee in compliance with university policies and procedures. Admission is selective and competitive and based on the number of well-qualified applicants, the number of available faculty to serve as mentors, and facilities. Those who meet stated minimum academic requirements are not guaranteed admission, nor are those who fail to meet those requirements necessarily precluded from admission, if they offer other appropriate strengths and/or experience.

### **B. Academic Preparation Requirements**

A Bachelor's degree from an accredited program is required for admission, preferably from a science-based curriculum (e.g., but not limited to, Animal Science, Food Science, Biology,

Nutrition, Physiology, Genetics, Microbiology, Chemistry, Biochemistry, or another appropriate discipline).

### **C. Application Deadlines**

Applications will be taken on a continuing basis to allow for admittance in either the Fall, Spring, or Summer Semesters. The deadlines for each semester are given below. Note: International applicant deadlines precede Domestic, US citizen applicants, due to additional timing requirements for obtaining an appropriate student visa.

- Fall:** June 1 (International applicants)  
August 1 (Domestic applicants, US citizens)
- Spring:** December 15 (International applicants)  
January 15 (Domestic applicants, US citizens)
- Summer:** April 1 (International applicants)  
May 1 (Domestic applicants, US citizens)

### **D. Types of Admission**

- **Regular Admission:** Regular admission is offered to students who meet all of the established entrance requirements.
- **Conditional Admission:** Successful applicants are typically admitted conditionally because stated information is self-reported and uploaded documents are unofficial. Fulfilling the conditions stated on an offer of conditional admission by the first date of graduate coursework is critical, so the instructions stated on the letter must be followed carefully. Failure to clear all stated conditions by the start of graduate coursework may result in revocation of admission to the graduate program.

## **II. Admission Requirements and Application Procedures for Course-Based MS Degrees, 4+1 Programs**

### **A. Timeline and degree information**

- 4+1 students may apply to one of the 4+1 degree programs during their junior or senior year. Students applying in their junior year must have completed the equivalent of at least 2 years of full-time course work in an undergraduate major in Animal Bioscience, Animal Science, Pre-Veterinary Medicine, or Food Science at UD. Students applying in their senior year must have at least one full semester of coursework remaining. Students are admitted to the 4+1 before they graduate with an undergraduate degree so that they can begin enrolling in graduate courses during their junior and/or senior year.
  - a. Students should consult with their advisor early in the program to ensure they choose appropriate coursework.

- b. Students apply and are admitted to the 4+1 program as sophomores, juniors, or seniors. If admitted, during their third and fourth years of study (or equivalent) they can begin taking courses required for earning an MS with up to 7 of the earned credits eligible to be counted toward the undergraduate degree and the MS degree. These courses must be grades of B or better to be approved to be transferred into the MS degree requirements.
- c. Students successfully completing the program will earn a B.S. from an undergraduate degree program and an MS, both from UD.

**B. Criteria for admission to the 4+1 programs with an MS will include:**

- Completion of all credits in the first 4 semesters of the undergraduate degree as shown on the undergraduate transcript
- A minimum cumulative GPA of 3.0 at the time of application.

**C. The following materials are required:**

- Online application using the Abbreviated 4+1 application form.
- UD transcript
- Graduate course Approval Form for 4+1 Admission. This form must be signed by the undergraduate advisor and the Graduate Program Director.
- Two (2) letters of recommendation from UD faculty members and/or advisors sent directly to the ANFS Graduate Program Director. (Note, these forms cannot be uploaded in the 4+1 app)
- Personal statement
- The application fee is waived for 4+1 applicants.

**III. Degree Requirements for Course-Based MS Degrees**

**A. M.S. Degree in Applied Animal Science or Food Technology**

- **Learning Goals**

Students completing the MS degree in Applied Animal Science will:

- a. Demonstrate functional knowledge and skills in animal science by proposing solutions to common challenges in animal science.
- b. Apply knowledge and skills in leadership, organization, project management, ethics, and entrepreneurship to identify and solve relevant challenges in animal science.
- c. Design and execute a problem-solving project related to a current issue in animal science.

Students completing the MS degree in Food Technology will:

- 1. Demonstrate functional knowledge and skills in animal science by proposing solutions to common challenges in food science.
- 2. Apply knowledge and skills in leadership, organization, project management,

ethics, and entrepreneurship to identify and solve relevant challenges in food science.

3. Design and execute a problem-solving project related to a current issue in food science.

- **Degree Requirements**

The MS degrees in Applied Animal Science and Food Technology are intended for applicants who want to further their academic training in animal or food science, but who are not research-oriented, but may be seeking a management position in an animal or food science career. This degree requires satisfactory completion of 30 hours of graduate-level coursework, including a Problem-Solving Project, as described below.

- **Course Requirements**

A total of 30 credit hours is required, including the Animal and Food Science Core (18 cr.), an Ethics course (3 cr.), a Problem-Solving Project (3 cr.), and PLUS courses (6 cr.).

- a. **Animal or Food Science Core (18 cr. hrs.)**

A total of 18 credit hours of graduate-level courses, of which 12 credit hours must be ANFS courses with a focus on animal science OR food science.

- b. **Ethics Course (3 cr.) Select one course.**

UAPP 650 - Values and Ethics of Leadership (3 cr.)

BUAD 640 - Ethical Issues in Domestic and Global Business Environments (3 cr.)

- c. **Problem Solving Project (3 cr.)**

ANFS (or corresponding department code if supervised by a faculty member in a different department) 666 (3 cr.) - The degree candidate will conduct a faculty-mentored problem-solving project. The faculty mentor can be the student's advisor or another faculty member from inside or outside of the department. This project may be an action program, the development of a plan to address a pertinent problem, the development of materials or methodology suited to the student's situation, or the development and execution of research appropriate to the profession. This course will require both written and practical evaluation as determined by the faculty mentor.

**d. PLUS, courses (6 cr.)**

Select any of the two courses listed below.

**i. Leadership and Organization**

BUAD 670 - Managing People, Teams, and Organizations (3 cr.)

BUAD 678 - Leading Across Boundaries (3 cr.)

UAPP 697 - Leading Organizations in Public & NP Sectors (3 cr.)

**ii. Project Management, Operations, or Entrepreneurship**

ENTR 616 – Applied Creativity (3 cr.)

ENTR 658 – Developing new Technology-Based Products (3 cr.)

ENTR 660 - High Technology Entrepreneurship (3 cr.)

MISY 640 - Project Management and Costing (3 cr.)

UAPP 689 - Information and Technology in Public & NP Organizations (3 cr.)

UAPP 684 - Performance Management and Program Evaluation (3 cr.)

**iii. Statistics (3 cr.)**

STAT 608 -Statistical Research Methods (3 cr.)

BISC 643 - Biological Data Analysis (3 cr.)

STAT 656 - Biostatistics (3 cr.)

• **Advising Requirement**

Students accepted into the Applied Animal Science and Food Technology MS degree programs will be assigned an advisor. The student has the responsibility to meet with their advisor to plan their course of study and project in the program. The advisor will provide feedback on course selection based on interests and undergraduate/graduate background.

**B. MS Degree in Animal Health**

• **Learning Goals**

Students completing the MS degree in Animal Health will:

- a. Demonstrate functional knowledge and skills in host-pathogen interactions, nutrition, and immunology.
- b. Apply technical training in cell and molecular biology techniques in research,

diagnostic, and clinical applications relevant to animal science.

- c. Demonstrate understanding of scientific methodology, experimental design, and data analysis through successful completion of an individual research experience.

- **Degree Requirements**

The M.S. in Animal Health is intended for applicants who want to further their academic training and desire additional hands-on training and research experience. Alternatively, they may come from an industry background and want to increase their skills and professional knowledge, while not being able to commit to a full-time, thesis-requiring graduate program. This non-thesis degree requires satisfactory completion of a minimum of 30 hours of graduate-level coursework as described below.

- **Course Requirements**

Course requirements for each of the required areas are listed in each section below.

Courses are subject to additions should appropriate courses become available. Any course substitutions must be approved by the ANFS Graduate Program Director and Faculty Advisor.

- a. **Host-Pathogen Core (9 cr. hrs.)**

Essential to an understanding of the concept of One Health is knowledge of host-pathogen interactions in the context of their environment. The Host-Pathogen Interactions Core is a total of 9 credit hours of graduate-level courses, of which 3 cr. hrs. must be from an ANFS course. Courses meeting these requirements are given, below:

| College | Department | Course # | Course Title                 |
|---------|------------|----------|------------------------------|
| CANR    | ANFS       | 635      | Animal Virology              |
| CANR    | ANFS       | 639      | Food Microbiology            |
| CANR    | ANFS       | 640      | Comparative Histopathology   |
| CANR    | ANFS       | 648      | Current Topics in One Health |
| CANR    | ENWC       | 611      | Insect Pest Management       |
| CAS     | BISC       | 625      | Cancer Biology               |
| CAS     | BISC       | 682      | Bacterial Pathogens          |

- b. **Nutrition and Immunology Core (6 cr. hrs.)**

Essential for an understanding of the concept of One Health is knowledge of how nutrition informs, and shapes host immune processes. This core is composed of 6 cr.

hrs. of graduate-level courses, 3 cr. hrs. of which must be from ANFS. Courses meeting these requirements are given, below:

| College | Department | Course # | Course Title                   |
|---------|------------|----------|--------------------------------|
| CANR    | ANFS       | 624      | Monogastric Nutrition          |
| CANR    | ANFS       | 636      | Immunology of Domestic Animals |
| CANR    | ANFS       | 654      | Advanced Ruminant Nutrition    |
| CANR    | ANFS       | 655      | The Gut Microbiome             |
| CANR    | ANFS       | 675      | Veterinary Biochemistry        |
| CAS     | NSCI       | 640      | The Immune System & Behavior   |

**c. Technical and Practical Training (9 cr. hrs.)**

This core requires the acquiring of real-world, hands-on skills for accomplishing research tasks. The Technical and Practical Training Core is a total of a minimum of 9 credit hours of graduate-level courses. Courses providing these skills are given in the table, below:

| College | Department | Course # | Course Title                                    |
|---------|------------|----------|-------------------------------------------------|
| CANR    | ANFS       | 644      | Bioinformatics                                  |
| CANR    | ANFS       | 650      | Applied Biomedical Communications               |
| CANR    | ANFS       | 671      | Paradigms in Cell Signaling                     |
| COE     | BINF       | 644      | Bioinformatics                                  |
| COE     | BINF       | 650      | Protein Modifications                           |
| COE     | BINF       | 694      | Systems Biology I                               |
| CAS     | CHEM       | 624      | Principles of Mass Spectrometry                 |
| CAS     | CHEM       | 645      | Protein Structure and Function                  |
| CAS     | CHEM       | 646      | DNA-Protein Interactions                        |
| CENG    | BMEG       | 679      | Introduction to Medical Imaging Systems         |
| HESC    | MMSC       | 603      | Research Design and Statistics                  |
| HESC    | MMSC       | 608      | Molecular Prep. Techniques                      |
| HESC    | MMSC       | 625      | Basic Recombinant DNA Techniques                |
| HESC    | MMSC       | 626      | Protein Purification and Characterization       |
| HESC    | MMSC       | 627      | Flow Cytometry                                  |
| HESC    | MMSC       | 635      | Practical Genomics, Proteomics & Bioinformatics |
| HESC    | MMSC       | 651      | Cell and Tissue Culture Techniques              |
| HESC    | MMSC       | 691      | Human Molecular Genetics                        |
| HESC    | MMSC       | 692      | Application of Molecular Diagnostic Techniques  |

**d. Research Training and Data Analysis (3 cr. hrs.)**

This core requires the learning of approaches to statistical analysis of biologically-derived data. Courses providing these skills are given in the table:

| College | Department | Course # | Course Title     |
|---------|------------|----------|------------------|
| CANR    | STAT       | 608      | Research Methods |

|      |      |     |                          |
|------|------|-----|--------------------------|
| CAS  | BISC | 643 | Biological Data Analysis |
| CANR | STAT | 656 | Biostatistics            |

**e. Individual Research Experience (3 cr. hrs., in ANFS 668)**

The degree candidate will conduct a faculty-mentored research project. The faculty research mentor can be the student's advisor or another department faculty member. This experience is designed to provide a real-world application of the techniques and concepts developed during the course work. This course will require both written and practical evaluation as determined by the research mentor.

- **Advising Requirement**

Students accepted into the Animal Health MS program will be assigned an advisor. The student has the responsibility to meet with their advisor to plan their course of study and schedule their research experience in the program.

Advice will be given concerning course selection based on interests and undergraduate/graduate background.

**IV. Additional Policies for Course-Based MS Degrees**

**A. 4+1 Degree**

- **4+1 in Animal Science, Animal Bioscience, or Pre-Veterinary Medicine (BS) plus Applied Animal Science (MS)**

The Department of Animal and Food Sciences offers a combined 4+1 Bachelor of Science (BS) in Animal Science, Animal Bioscience, or Pre-Veterinary Medicine and a Master of Science (MS) in Applied Animal Science program that allows students to complete both degrees in a total of five years of full-time study. Students must be at least in their junior year of study and have completed at least 60 credits to apply for the 4+1 BS/MS program. Applications will be evaluated on a rolling basis by the department's graduate committee. This program is limited to current undergraduates in either the Animal Science, Animal Bioscience, or Pre-Veterinary Medicine major that have a cumulative grade point average (GPA) of at least 3.0 at the time of application. Students that do not meet this GPA criteria may still be considered upon recommendation of their advisor. Up to seven credits of graduate coursework (600 level and above) may be applied toward satisfying the requirements of both degrees. It is recommended that three of these credits be ANFS 675.

- **4+1 in Animal Science, Animal Bioscience, or Pre-Veterinary Medicine (BS) plus Animal Health (MS)**

The Department of Animal and Food Sciences offers a combined 4+1 Bachelor of Science (BS) in Animal Science, Animal Bioscience, or Pre-Veterinary Medicine and a Master of Science (MS) in Animal Health program that allows students to complete both degrees in a total of five years of full-time study. Students must be at least in their junior year of study and have completed at least 60 credits to apply for the 4+1 BS/MS program. Applications will be evaluated on a rolling basis by the department's graduate committee. This program is limited to current undergraduates in either the Animal Science, Animal Bioscience, or Pre-Veterinary Medicine major that have a cumulative grade point average (GPA) of at least 3.0 at the time of application. Students that do not meet this GPA criteria may still be considered upon recommendation of their advisor. Up to seven credits of graduate coursework (600 level and above) may be applied toward satisfying the requirements of both degrees. It is recommended that three of these credits be ANFS 675.

- **4+1 in Food Science (BS) plus Food Technology (MS)**

The Department of Animal and Food Sciences offers a combined 4+1 Bachelor of Science (BS) in Food Science and a Master of Science (MS) in Food Technology program that allows students to complete both degrees in a total of five years of full-time study. Students must be at least in their junior year of study and have completed at least 60 credits to apply for the 4+1 BS/MS program. Applications will be evaluated on a rolling basis by the department's graduate committee. This program is limited to current undergraduates in the Food Science, Food Science – Culinary Concentration, or Food Science – Operations and Management Concentration major that have a cumulative grade point average (GPA) of at least 3.0 at the time of application. Students that do not meet this GPA criteria may still be considered upon recommendation of their advisor. Up to eight credits of graduate coursework (600 level and above) may be applied toward satisfying the requirements of both degrees.

## **B. Degree Progress**

- **Academic load and progress**

The course-based MS degrees will follow the University of Delaware, Graduate College recommended policy for determining students' failure to make satisfactory progress towards degree requirements and time limits for completion. Students may be enrolled on

a full-time (9 credits per term) or part-time (fewer than 9 credits per term) basis.

- **Grade and GPA requirements**

Students must have a minimum overall cumulative grade point average of 3.0 to be eligible for the degree. In addition, the grades in courses specifically required for the degree program must average at least 3.0. All graduate-numbered courses taken with graduate student classification at the University of Delaware are applied to the cumulative index. *Credit hours and courses for which the grade is below "C-" do not count toward the degree, even though the grade is applied to the index.*

- **Academic Probation**

The Graduate College monitors the academic progress of all graduate students and notifies students in writing of all academic deficiencies. The cumulative GPA after each 9-hour increment determines academic standing. In addition to the University policy regarding minimum grade point averages, some departments require graduate students to maintain certain performance minima in their programs of study in all or in particular courses. Failure to meet the stated minima may lead to academic dismissal from the program.

**C. Financial aid**

There are no financial awards for this degree.

**V. Admission Requirements for Thesis-Based MS and PhD Degrees**

**A. All Applicants**

An applicant for graduate study in Animal and Food Sciences must have appropriate academic training. Preparation for most areas of study should include general and organic chemistry, general biology, microbiology, biochemistry, and calculus. Applicants lacking preparatory course work will be required to complete the appropriate courses(s) prior to admission. A minimum cumulative grade point average of 2.75 (4-point scale), and a 3.00 average in the major is required of applicants holding the bachelor's degree. The Graduate Record Examination (GRE) is optional. If included in the application, a combined score (quantitative + verbal sections) of 300 on a scale of 340 on the general exam is desirable. If the GRE is not submitted, applicants must provide other evidence of quantitative ability such as A or B grades

in math and advanced chemistry. Any scores submitted voluntarily by an applicant by an applicant will be evaluated holistically but will not be used to determine admission. Applicants must provide three letters of recommendation from former professors or supervisors, a completed Graduate Studies Application form, and a completed assistantship form (if applying for financial aid).

#### **B. International Applicants**

Students for whom English is not their first language, the required minimum scores on the TOEFL or IELTS are based on the University of Delaware graduate admission requirements (<https://www.udel.edu/academics/colleges/grad/prospective-students/grad-admissions/test-scores/>). Applicants may be requested to visit the department for a personal interview, or participate in a remote interview (Skype, Zoom or some other online platform) before a final decision concerning admission is made.

#### **C. General**

*In addition to the above conditions, admission to the graduate program is dependent upon availability of appropriate faculty expertise in the student's area of interest, advisor funding, as well as space in the laboratory of interest.*

Admission to the Graduate Program is performed by the Chair of the Graduate Committee in consultation with the Graduate Advisory Committee and the chosen advisor. Following admission to the University, a letter of offer is generated by the Department Chair detailing the admission status, advisor, and terms of the graduate contract.

### **VI. General Degree Requirements for Thesis- Based MS and PhD Degrees**

#### **A. M.S. Degree in Animal Science and M.S. Degree in Food Science.**

In the M.S. program in Animal Science, a student may specialize in animal nutrition, pathology, physiology, immunology, molecular biology, genomics, systems biology, management, or a combination of these disciplines (i.e., nutritional immunology, etc.).

In the M.S. program in Food Science, a student may specialize in food science, safety, microbiology or engineering.

- **Learning Goals.**

### **Learning goals for the thesis-based MS in Animal Science**

- a. Students will demonstrate mastery of core concepts in the animal sciences and how their research fits into the broader framework of One Health and agricultural sciences.
- b. Students will demonstrate critical thinking through use of primary literature and appropriate laboratory/computational tools to collect, analyze, and report their data and research results.
- c. Students will demonstrate the ability to apply the scientific method by formulating hypotheses, designing relevant experiments, validating methodology, and critically evaluating and interpreting findings.
- d. Students will demonstrate that they can write and graphically depict scientific data in a clear, organized, and accurate fashion tailored for a diverse range of audiences. Students will demonstrate the ability to orally communicate and defend ideas, concepts, and research findings. Students will develop personal and professional skills through networking, attendance at professional meetings, and seminar presentations.
- e. Students will demonstrate the ability to work with others on a team and engage in mentoring undergraduate students and peers through their research lab, teaching, and participation in the University community.

### **Learning goals for the thesis-based MS in Food Science**

1. Students will demonstrate mastery of core concepts in the food sciences and how their research fits into the broader framework of One Health and agricultural sciences.
2. Students will demonstrate critical thinking through use of primary literature and appropriate laboratory/computational tools to collect, analyze, and report their data and research results.
3. Students will demonstrate the ability to apply the scientific method by formulating hypotheses, designing relevant experiments, validating methodology, and critically evaluating and interpreting findings.
4. Students will demonstrate that they can write and graphically depict scientific data in a clear, organized, and accurate fashion tailored for a diverse range of audiences. Students will demonstrate the ability to orally communicate and defend ideas, concepts, and research findings. Students will develop personal and professional

skills through networking, attendance at professional meetings, and seminar presentations.

5. Students will demonstrate the ability to work with others on a team and engage in mentoring of undergraduate students and peers through their research lab, teaching, and participation in the University community.

- **Time Limitation**

The programs are normally completed in 2 to 2 ½ years of full- time study. All requirements for the Master's degrees must be met within a maximum of 10 consecutive semesters.

- **Credits**

A minimum of 30 graduate credit hours is required., of which 6 credits must be ANFS 869 Master's Thesis. The student must have a minimum cumulative grade point average of 3.00 (4-point scale) in order to receive the M.S. degree.

- **Core Courses**

All students pursuing the M.S. degree will complete the following core courses:

- ANFS 865 Seminar (1 cr.)
- ANFS 869 Master's Thesis (6 cr.)
- CHEM 527 Introductory Biochemistry (3 cr.) or CHEM 641 Biochemistry (3 cr.) or ANFS 670 Principles of Molecular Genetics (3 cr.) or ANFS 675 Veterinary Biochemistry (3 cr.) or an appropriate equivalent Biochemistry course as approved by the student's Graduate Committee
- STAT 608 Statistical Research Methods (3 cr.) or STAT 615 Design and Analysis of Experiments (3 cr.) or BISC 643 Biological Data Analysis (3 cr.) or an equivalent statistic course as approved by the student's Graduate Committee.

- **Elective Courses.**

The remaining courses, totaling not less than 17 credit hours, will be determined by the student, faculty advisor and the Graduate Committee. These courses will vary among

students depending on their specific needs to carry out their research and complete the program. Elective courses taken by students pursuing the M.S. in Animal Science include, but are not limited to, those with the ANFS, BINF, BISC, CHEM, and STAT designations. Elective courses taken by students pursuing the M.S. in Food Science include, but are not limited to, those with the ANFS, BINF, BISC, CHEM, STAT, CHEG, MATH, MEEG, PLSC, PHYS, and NTDT designations (see Graduate Course Offerings). A maximum of 6 credits of ANFS 668/868 may be applied towards these 17 elective credits. ANFS 666/866 Special Problem must be taken as a titled course to count toward these 17 elective credits.

- **Graduate Committee.**

Each student will have a Graduate Committee consisting of at least three faculty or professional members nominated by the faculty advisor and approved by the Department Chairperson. The advisor, who serves as the chair of the committee, must be an ANFS faculty member. The Graduate Committee's responsibility is the evaluation of the student's program, thesis, and examination. Participation of outside individuals from industry, government, or other academic departments on Graduate Committees may be required depending on the student's area of research and the availability of faculty expertise within the department. Departmental Adjunct Faculty and non-faculty Professional Staff shall be considered as outside members in their participation on Graduate Committees. However, not more than half of the Graduate Committee members shall be considered as outside members. The Department Chairperson is considered an *ex officio* member of all Graduate Committees.

- **Research Proposal.**

A research topic shall be determined in conference between the faculty advisor and the student. The student will prepare a research proposal containing pertinent background material including a literature review, specific objectives of the research project, and methods to be used in the planned studies. It is suggested that the proposal be a minimum of 15 pages double spaced, using 12-point font. The proposal shall be submitted to the student's Graduate Committee for review and approval of the research project. A proposal review meeting shall be held **prior to the completion of the first year following matriculation.** The proposal shall be submitted to the committee members at least ten working days prior to the scheduled meeting. The student will give an oral presentation

summarizing the proposal. The committee members will question the student to verify that the student understands the research problem and the experimental approaches needed to address it. The Committee will also ensure that the student has the proper training and resources to do the research. As a result of the proposal review meeting, the student may be required to revise the proposal and/or take additional relevant course work.

- **Thesis**

A thesis reporting the objectives, procedures, results, and a discussion of the student's research shall be prepared according to the most recent edition of the *Thesis Manual* prepared by the Graduate College. Copies of the thesis shall be submitted to the student's Graduate Committee at least ten working days prior to the final examination. It is highly recommended that the student presents his/her results at an appropriate scientific meeting and prepare a manuscript(s) based on his/her research results in a form suitable for publication. Published thesis research is acceptable as part of the thesis. At the discretion of the advisor, students may be required to provide a draft manuscript at the time of the defense.

- **Thesis Defense**

Upon completion of the thesis, the student is required to give an oral presentation (seminar) summarizing the thesis research. Following questions from the public, the committee members will question the student about the thesis and related subject areas to verify that the student fully understands the research findings and their implications. A favorable vote of at least two-thirds of the committee members is required to pass.

**B. The Doctor of Philosophy (Ph.D.) Degree in Animal and Food Sciences.**

The Doctor of Philosophy Degree has become the highest mark of achievement awarded for the demonstrated ability to investigate problems independently. Doctoral study devotes itself to developing the student's capacity to make significant contributions to knowledge through the development of a critical, disciplined mind. This training is best accomplished under the full-time student status in order to maximize the interaction of the student with a scientific group.

- **Learning Goals**

**a. Scientific competency**

1. Students will demonstrate mastery of broad content specific knowledge through analysis of literature, integration of their research into the context of previous work, and critical thinking about the broader implications of their work.
2. Students will develop and use appropriate laboratory and computational tools to collect, analyze, and report their data and research results.
3. Students will demonstrate the ability to apply the scientific method by formulating hypotheses, design relevant experiments, validate methodology, and critically evaluate and interpret findings appropriately.
4. Students will produce a significant, novel research contribution to their discipline.

**b. Oral, written, and graphical communication.**

1. Students will demonstrate the ability to write and graphically depict scientific data in a clear, organized, and accurate fashion tailored for a diverse range of audiences.
2. Students will demonstrate the ability to orally communicate and defend ideas, concepts, and research findings.
3. Students will demonstrate proficiency in and awareness of appropriate software use for their discipline.

**c. Ethics and habits of mind**

1. Students will demonstrate an understanding of the importance of ethical practice in data collection, analysis, and reporting.
2. Students will recognize and advocate for the role science plays in society as a whole.
3. Students will demonstrate unbiased critical thinking, an openness to diverse ideas, professional empathy, and the ability to work with others on a team.
4. Students will engage in mentoring undergraduate students and peers through their research lab, teaching, and participation in the University community.

**d. Professional Development**

1. Students will develop personal and professional skills through networking, attendance at professional meetings, and seminar presentations.
2. Students will participate in career exploration in academics, government,

industry, and allied occupations.

- **Admission**

Students may enter the Ph.D. program after having previously earned a bachelor's degree (B.A. or B.S.), an M.S. degree, or a Doctorate in Veterinary Medicine (DVM), or equivalent. A student who has been admitted to the Ph.D. program in Animal and Food Sciences may begin working toward the degree. However, he/she has no official status as a doctoral candidate until he/she has passed the comprehensive examination.

- **Areas of Specialization**

The Ph.D. degree in Animal and Food Sciences will be granted in the following major areas of specialization: animal nutrition, pathology, physiology, immunology, molecular biology, genomics, systems biology, management, food science, safety, microbiology or engineering, or a combination of these disciplines (i.e., nutritional immunology, etc.). In addition to the major area of specialization, the student's advisor, in consultation with the Doctoral Committee, will determine whether the student should pursue a minor field of specialization. If a minor field of specialization is selected, the committee will judge the suitability of the field, relevance to the major area of specialization, and requirements for the minor.

- **Time Limitation**

A maximum of 14 consecutive semesters beyond the bachelor's degree, or 10 consecutive semesters beyond the master's degree, is allowed to complete the requirements for the Ph.D. degree.

- **Core Courses and General Requirements.**

All students pursuing the Ph.D. will complete the following core courses:

- ANFS 865 Seminar (1 cr.),
- ANFS 969 Doctoral Dissertation (9 cr.),
- CHEM 641 Biochemistry (3 cr.) or ANFS 675 Veterinary Biochemistry (3 cr.) or an equivalent metabolism-focused biochemistry course as approved by the student's Doctoral Committee,

- CHEM 642 Biochemistry (3 cr.) or ANFS 670 Principles of Molecular Genetics (3 cr.) or an equivalent nucleic acid-focused biochemistry course as approved by the student's Doctoral Committee.
- Statistics course: STAT 608 Research Methods (3 cr.), STAT 615 Design and Analysis of Experiments (3 cr.), BISC 643 Biological Data Analysis (3 cr.), or an equivalent statistic course as approved by the student's Doctoral Committee.

Beyond the core courses, no specific number of courses completed, or credits earned are uniformly required. The student and advisor, in concert with the Doctoral Committee, will select appropriate course work based on the student's background and major and minor (if applicable) area(s) of specialization for the Ph.D.

Consideration will be given to the student's prior training and experience at the undergraduate (B.A. or B.S.) and M.S. and/or D.V.M. (if applicable) level(s). Students with more advanced training and experience will need fewer courses to complete their Ph.D. program. General requirements for the Ph.D. are based on a period of residency, writing of a satisfactory research proposal and dissertation, and passing the comprehensive examination and the final dissertation defense. The candidate's doctoral program will consist of a combination of Doctoral Committee approved formal courses, seminars, individual study, and research credits as needed by the student.

- **Residency Requirements**

At least one continuous academic year (two semesters) must be devoted to full-time study as a registered student in the major field at the University of Delaware. Full-time study consists of a minimum load of nine credit hours per semester.

- **Advisor and Doctoral Committee**

Most applicants to the Ph.D. program identify a potential faculty advisor at the time of application. If that faculty member is unable (due to lack of space, funding, etc.) to advise the student, then another advisor who is acceptable to the student is sought. If an advisor cannot be identified, then the student is not admitted to the Ph.D. program. As a condition of admission into the program, a faculty member must agree to serve as the student's graduate advisor for the balance of the student's program. A student may change advisors,

but this is very rare (see Section IV.D., Evaluation of Graduate Student Progress). **A Doctoral Committee will be appointed within six months following matriculation.** The committee shall consist of not less than four and no more than six faculty or professional members nominated by the graduate advisor and approved by the Department Chairperson. Participation of outside individuals from industry, government or other academic departments on the Doctoral Committee may be required, depending on the student's area of research and the availability of faculty expertise within the department. Departmental Adjunct Faculty and non-faculty Professional Staff shall be considered as outside members in their participation on Doctoral Committees. At least one member of the committee shall be from outside the Department of Animal and Food Sciences. However, not more than half of the Doctoral Committee members shall be considered as outside members. The Department Chairperson is considered an *ex officio* member of all Graduate Committees. The committee is responsible for approving the student's course work and research program. The committee will prepare, administer, and evaluate the student's comprehensive and final examinations and will supervise and approve the dissertation. The student's faculty advisor serves as chair of the Doctoral Committee. A faculty member may serve as the graduate advisor for a student in both his/her M.S. and Ph.D. programs, although this is not common. Students who have completed the M.S. Degree in Animal Science or the M.S. Degree in Food Science are generally encouraged to pursue the Ph.D. at other universities.

- **Research Proposal**

Advancement to degree candidacy requires successful oral defense of a research proposal. It is suggested that the proposal be a minimum of 15 pages double spaced, using 12-point font. The proposal will be submitted to the Doctoral Committee at least ten working days prior to the scheduled defense. The student will give an oral presentation summarizing the proposal. The committee members will question the student to verify that the student understands the research problem and the experimental approaches needed to address it. The committee will also ensure that the student has the proper training and resources to do the research. As a result of the meeting, the student may be required to revise the proposal and/or take additional course work. The research proposal defense should precede the comprehensive examination.

- **Comprehensive Examination.**

Successful completion of the comprehensive examination is required of all Ph.D. students prior to their admission to candidacy. The examination normally is given to the student after completion of all course work and selection of a dissertation topic. The student is required to have a minimum grade point average of 3.0 (4-point scale) at the time of the examination.

### **Format of the Comprehensive Qualifying Examination**

The Department of Animal and Food Sciences recognizes several formats for the Comprehensive Qualifying Examination. The format of the examination to be used is at the discretion of the major advisor.

### **Possible Formats**

- a. **Research Proposal:** The written portion of the Qualifying Examination will be a research proposal following the formats of one of the following Government agencies: USDA (NIFA), NIH or NSF. The topic of the proposal must be outside the primary area of study of the graduate student and will be decided with the input and agreement of the Doctoral Committee. The student must follow all formatting and page restrictions of the chosen granting agency and must include references cited in an accepted bibliographical format, essentially generating the Project Description portion of the proposal, only. The student will have one month to prepare the proposal, which must then be distributed to committee members at least 2 weeks prior to the presentation and defense of this proposal. The format of the defense will be a 30 – 45 min presentation, followed by a question-and-answer period that will initially focus on the proposal, but can be expanded to include other areas, as determined by the committee.
- b. **Combination Written and Oral Examination:** Each member of the student's Doctoral Committee will submit questions to the student via the advisor who will administer the written portion of the comprehensive examination. Following completion of the written exam, the advisor will return the student responses to the appropriate committee member for their evaluation. Each committee member will then inform the student and major advisor of the outcome of their respective examinations, in writing. Students passing the written examination may continue for the oral portion of the comprehensive examination before the full Doctoral

Committee, generally given within one month of the completion of the written examination. In the oral portion of the comprehensive examination the student must appear before all committee members and demonstrate competency in this forum.

### **Comprehensive Examination Outcome**

Following the question-and-answer period, the student will be excused, and the committee will discuss the performance of the student and decide (by majority vote) on one of the following outcomes:

- |                            |          |                                                                                                                                    |
|----------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------|
| (1) Pass, unconditionally, | Outcome: | student admitted to doctoral candidacy                                                                                             |
| (2) Pass, conditionally,   | Outcome: | student admitted to doctoral candidacy after meeting certain conditions (take an additional class, re-write passage of exam, etc.) |
| (3) Fail, conditionally,   | Outcome: | student must re-take entire examination within three months                                                                        |
| (4) Fail, unconditionally, | Outcome: | student dismissed from graduate or must complete current work for Master's degree                                                  |

The student will then be re-admitted to the room and told of the decision of the committee.

- **Dissertation**

The ability to conduct independent research and competence in scholarly writing must be demonstrated by the preparation of a dissertation on the main topic of specialization in accordance with the regulations of the Graduate College. The contents and conclusions of the dissertation must be defended at the time of the final oral defense (see below) and approved by the Doctoral Committee. Copies of the dissertation must be provided to committee members at least ten working days before the date of the final oral examination. Preparation of a manuscript(s) for publication of the information contained within the dissertation is expected prior to, or within one month after, approval of the dissertation by the committee at the final oral examination.

- **Dissertation Defense.**

Upon recommendation of the Doctoral Committee, a final oral defense of the dissertation will be scheduled for the doctoral candidate who has satisfied all other requirements for the degree. The examination must be scheduled at least two weeks prior to the time the examination is to be held. The examination, which is open to the public, shall be related in a large part to the dissertation, but it may cover the entire field of study of the candidate. The examination will be administered by the student's Doctoral Committee. The student will give an oral presentation (seminar) summarizing the dissertation research, followed by a period of public question and comment. The Committee members will then dismiss the public and question the student about the dissertation and related subject areas to verify that the candidate fully understands the research findings and their implications. A favorable vote of a majority of the members of the committee is required to pass. If the candidate fails, it is the responsibility of the Doctoral Committee to determine whether he/she may take another examination.

## **VII. Additional Graduate Policies, Procedures and Program Assessment**

### **A. Graduate Seminar**

Enrollment in the graduate seminar is required of each graduate during his/her first semester in the department graduate program. Although formal enrollment is not required in subsequent semesters, attendance is required at all seminars each semester of the student's graduate program. A grade designation of "S" will be assigned at the end of the first semester and carried to the completion of the student's graduate program. At that time, a letter grade, based upon performance and participation of the student in seminars each semester of his/her program, will be assigned by the instructor of record when the student was enrolled. Generally, seminar presentations will be made by outside speakers each fall semester, and graduate students will be responsible for presentations each spring semester.

### **B. Graduate Assistantships and Fellowships**

Students are nominated for assistantships based on the needs of the department and qualifications of the students. It is anticipated that not less than one-half of the students admitted will receive some type of financial support.

### **C. Graduate Student Teaching**

All graduate students, especially Ph.D. candidates, are expected to assist in the teaching of at least one course in the department (guest lectures, proctoring exams, grading, etc.).

### **D. Evaluation of Graduate Student Progress**

If a graduate student, his/her faculty advisor, a member(s) of his/her Graduate (Doctoral) Committee, or the Department Chairperson perceives that the graduate student is not making satisfactory progress toward his/her degree, an evaluation of the student's progress will be conducted by the Graduate Advisory Committee and Department Chairperson. If, in the opinion of the Graduate Advisory Committee, the student is not making satisfactory progress, the student and advisor will be notified, and the Department Chairperson advised in writing of any actions the Graduate Advisory Committee feels necessary. The student and/or advisor will have the opportunity to meet with the Graduate Advisory Committee and/or Department Chairperson, as a group or on an individual basis, to discuss the Committee's actions. Possible outcomes of this action include reassignment of the student to another faculty advisor or termination of the student from his/her graduate program.

Termination of a graduate student from his/her program is rare. Conditions for termination may include any one of the following:

- Failure to maintain a grade point average of 3.0 (4-point scale) throughout the student's program.
- Failure to make adequate progress in the student's research required for the degree (see above), or as consequence of failing the comprehensive examination.
- Unethical professional conduct (plagiarism, fabrication of data, sabotage of another's experiment, etc.).

Specific details on the University's conduct expectations of students are given in the section entitled, "Student Guide to University Policy" in the University of Delaware Official Student Handbook.

### **E. Transfer Credits**

Up to nine graduate credits taken at UD with the classification of CEND (Continuing Education Nondegree) or earned from another institution may be applied to toward the graduate degree, in accordance with [UD Graduate College policies](#). Transfer of credit must be

approved by the Graduate Program Director after consultation with the Graduate Advisory Committee, and the credits cannot have been applied to obtain a different degree. Transfer of credits does not apply to 4+1 degrees.

## **F. Graduate Program Assessment**

- **Assessment Plan for Non-thesis Master's Program with a Concentration in Business, Entrepreneurship, and Leadership**

| <b>Assessment plan for Non-thesis Master's Degree Concentrations in Animal or Food Science</b>                                                                                      |                                                                                                                       |                                                                                                                                                                                                                 |                                                                                                                                                                          |                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| <b>Objectives</b>                                                                                                                                                                   | <b>Strategic Activities</b>                                                                                           | <b>Measures</b>                                                                                                                                                                                                 | <b>Short-term Outcomes</b>                                                                                                                                               | <b>Long-term Impact</b>                                                                                                    |
| <b>1. Demonstrate functional knowledge and skills in animal/food science by proposing solutions to common challenges in animal/food science</b>                                     | Course work covering the disciplines of animal or food science                                                        | Faculty evaluation of student progress in coursework.<br>Surveys of graduate students in the program and post-graduation                                                                                        | Students are prepared for subsequent coursework                                                                                                                          | Graduates enjoy long term success in animal and food science careers.                                                      |
| <b>2. Apply knowledge and skills in leadership, organization, project management, ethics, and entrepreneurship to identify and solve relevant challenges in animal/food science</b> | Coursework in ethics, communication, leadership, entrepreneurship, management, statistics, and other approved courses | Surveys of students focusing on their experiences in these classes.<br>Surveys of graduates to determine the utility of these classes to their career.<br>Faculty evaluation of student progress in coursework. | Course work for the NON-THESIS OPTION degree helped students secure initial employment<br>Students and graduates report applying knowledge from courses to work settings | Acceptance to Professional and/or Graduate School.<br>Graduates enjoy long term success in animal and food science careers |
| <b>3. Design and execute a problem-solving project related to a current issue in animal/food science</b>                                                                            | Identify a problem and potential solution and design project to solve the problem.                                    | Quality of the project study design and results.<br>Faculty evaluation of quality and scope of the project.                                                                                                     | Surveys of graduates to determine the utility of their project experience to their career.                                                                               | Graduates enjoy long term success in animal and food science careers.                                                      |