

# Molecular Medicine and Translational Sciences MS Curriculum

## DETAILED DESCRIPTION OF COURSES/REQUIREMENTS

### First Year

**1. THESIS MENTOR AND ADVISORY COMMITTEE.** MS students should choose a thesis research mentor and a research project before entering the MMTS MS program and must be able to devote at least 75% of their faculty effort to research. The choice of mentor must be approved by the Co-Directors of the MMTS graduate program. In consultation with the mentor and the Co-Directors of the MMTS graduate program, a faculty advisory committee should be appointed during the first year in the program. The committee must comprise an advisor from the MMTS program, a second faculty member from within the program, and a third member either from outside the program or outside the student's area of concentration. All members of the advisory committee should be members of the graduate faculty. Before submission of the thesis, the committee will be officially appointed by the dean of the Graduate School. With the approval of his or her advisor, a student may recommend a person who is not on the graduate faculty to serve on the examining committee as a voting member; however, the committee must have a minimum of two members from the Graduate Faculty. The thesis advisor must justify the participation of this person on the basis of research, publications, and/or professional activities in a letter to the dean requesting approval.

### **2. MCB 700 Analytical Skills (1)**

**Offered: Fall**

This 1-credit course focuses on data acquisition and analysis methods. Balancing theory and practice, it will refresh mathematical skills; describe techniques for isolating and characterizing cells and their macromolecular components; explore methods for manipulating genes and performing high-throughput assays; and introduce bioinformatics approaches. A series of take-home exercises reinforce problem-based learning. MCB 700 will be offered as 10 x 1.5 h. sessions in the two weeks preceding fall term.

**3. STATISTICS** MMTS students must take a course in statistics. The requirement can be satisfied by taking one of the following three courses:

### **THSS 730. Introduction to Statistics. (4)**

**Offered: Fall**

Introduction to statistical concepts and basic methodologies that are prevalent in biomedical literature. Includes discussion topics such as: descriptive statistics, probability, sampling distributions, hypothesis testing, simple linear regression, correlation, one-way analysis of variance, categorical data analysis, survival analysis, sample size and power analysis, and nonparametric methods.

### **HES 721. Data Analysis and Interpretation. (3)**

**Offered: Fall** (Reynolda Campus)

The application of basic statistical techniques in the analysis and interpretation of data in scientific research. Topics include descriptive statistics, simple linear and multiple correlation/regression analysis, t-tests, analysis of variance and covariance, and non-parametric statistics.

### **IPP/NEUR 741. Quantitative Methods in Bioscience. (3)**

**Offered: Fall**

An introduction to essential concepts and methods for the quantitative analysis of biological data, with a focus on descriptive and inferential statistics. General topics include basic concepts in statistics such as probability theory and chance models, samples and populations, analyses of the relationships between variables, analysis of normal data, analysis of non-normal data and non-parametric analyses, an introduction to Bayesian frameworks, clustering analysis, and multivariate analyses. Didactic lectures cover core frameworks, analytic approach, and the mechanics and intuitive logic behind the methods. Laboratory sessions provide experience using a software platform (R) for data analysis and visualization using practical problems.

**4. ETHICS.** Students must take a course in scientific and biomedical ethics. The requirement can be satisfied by taking one of the following two courses.

**GRAD 713 (1), 714 (1). Scientific Professionalism and Integrity**

**Offered: Fall and Spring**

The Problem-Based Learning Method (PBL) is used to teach students in small groups to identify discipline-specific and broad professional norms and obligations for the ethical practice of science. Content will include the norms and principles for the responsible conduct of scientific research such as data acquisition, management, sharing and ownership, publication practices, and responsible authorship. Emphasis will be placed on learning the tenets of responsible conduct of research, the current regulatory and legal climate, as well as the underlying norms and principles that shaped these concepts. Topics will include the student and advisor relationship, laboratory dynamics, collaborations in science, appropriate handling of data and appropriation of credit, plagiarism, conflicts of interest and financial responsibility. Students will acquire skills to recognize ethical issues in the practice of science, identify role obligations, and develop sound ethical reasoning to address these issues. The courses also include plenary session presentations by experts on topics of professional development, such as preparing manuscripts and grant applications and policies regarding conduct of animal and human subject research.

**CPTS 703 (1), 704 (1). Ethics and Responsibility in Clinical and Population Translational**

**Science.** Provides students with an overview of topics related to ethics and the responsible conduct of human subjects research. Students utilize a case-based format to address such topics as: study oversight and research design, informed consent, selection of subjects, conflicts of interest, the social effects of research, the use of embryos, fetuses and children in research, genetic research, and authorship and publication of study findings. Students are required to complete the Collaborative Institutional Training Initiative (CITI).

**5. MMTS 711, 712. Translational Science Seminar Series. (1, 1)**

**Offered: Fall and Spring**

Faculty and students jointly describe their research in a human disease, first in clinical terms and then to follow the development of the understanding of that disease to the molecular level with an emphasis on translational applications. Presentations introduce students to potential preceptors and experimental strategies used to study human disease. Students present their own research to gain experience and professional skills for seminars and national meeting presentations.

**6. MMTS 724. Scientific Development and the Business of Science. (3)**

**Offered: Spring**

Review of techniques for effective communication of scientific proposals and presentations, both oral and written. For oral presentations, emphasis is on content organization and connecting with the audience. Assignments include the presentation and critical discussion of papers by the students. For written presentations, the emphasis is on grant proposal development, as well as familiarization with the peer-review process. The course consists of lectures on all aspects of grant development (including budgets and protocols and compliance regulations for human and animal research), and student preparation of a grant proposal. An oral exercise includes the discussion of an NIH RO1 proposal in a mock study section format.

**7. ELECTIVES.** MMTS MS students must take a total of 9-10 hr in elective coursework and are encouraged to complete this requirement during the first year. Students are encouraged to consult with their advisors and choose electives that complement their area of research. Students may choose any graduate level courses in the sciences.

**8. RESEARCH.** MMTS MS students must sign up for the MMTS research course each semester. The number of hours for research varies, depending on the hours taken in other courses, but must be at least 1. The total number of hours (including coursework and research) must equal at least 6 in the summer term and at least 9 each semester.

**MMTS 791, 792. Research. (1-9)**  
**Offered: Fall, Spring, and Summer**

Involves closely supervised research in various topics in molecular medicine, with a special emphasis on models of human disease, including research in preparation for the doctoral dissertation.

**Second Year**

- 1. RESEARCH.** The focus of this year should be progress on the student's research project with the goal of graduation by August (the end of the summer term). Students sign up for Research each semester.
- 2. COURSES.** Students must take Translational Science seminar in the fall and spring semesters and should follow the graduate school guidelines for registration for final semester before graduation.
- 3. ELECTIVES.** Students should have completed their elective requirements during the first year, but may take elective courses this year if needed.
- 4. PUBLICATION AND THESIS REQUIREMENTS.** MMTS MS students should strive to complete their coursework and research in order to graduate in August of their 2<sup>nd</sup> year (end of summer term). The thesis must be written and submitted to the graduate school for approval at least 6 weeks before the August graduation date. It must be submitted to the advisory committee for approval at least 5 weeks before the August graduation date. The committee must notify the graduate school of its' approval of the thesis no later than 10 days before the scheduled examination. If the thesis is approved by the committee, the thesis examination must take place at least 2 weeks before the August graduation date (dates are provided in the official Graduate School calendar). The examination consists of a seminar presentation by the student, followed by a question and answer period conducted by the advisory committee. The possible committee decisions are unconditional pass, pass upon rectifying deficiencies, and fail. If a student fails, he/she may be reexamined only once.

It is recommended that students also write and submit one or more manuscripts that report their thesis research prior to graduation.