

## **Course Descriptions for Biotechnology Masters of Science Degree**

Students must complete 16 credit hours in core courses, 8 credit hours in track-specific courses, 9 credit hours in faculty mentored research, and 4 credit hours in seminar for a total of 37 credit hours. Syllabi for these courses are included as Appendix VIII. The curricular order and a brief description of courses are specified below.

**\*\*Please note: The Masters of Science Degree in Biotechnology can be completed in two years, but the student should allot/plan additional time to satisfy all degree requirements.**

### **First Year—Semester I (Nine Credit Hours Total)**

**Biotechnology I—Genetic Engineering, BTEC 501.** Principles of molecular biology, recombinant DNA technology, transgenic organisms, AND cloning vectors. Three credit hours.

**Laboratory in Genetic Engineering, BTEC 511.** Laboratory applications of theoretical concepts taught in BTEC 501. Allows hands-on integration of diverse biotechnical applications to answer research questions *via* laboratory investigation. One credit hour.

**Research Ethics, BTEC 531.** An overview of current scientific, regulatory and ethical issues in biotechnology. Ethical issues in research including, but not limited to: contemporary issues in bioethics, scientific misconduct, human subjects research, animal care, conduct of responsible research and requirements of regulatory agencies. Two credit hours.

**Teaching & Leadership, BTEC 593.** Workshops in strategies of teaching, learning, and leadership. Review of scholarship of teaching and learning. Practice in student-centered active-learning pedagogical methods. Assessment of student learning outcomes. Syllabi evaluation and design. Workshop in conflict resolution. Two credit hours.

**Seminar I, BTEC 591.** Department faculty give research presentations. Students read scientific papers related to the faculty research (literature review due at beginning of faculty research presentation). Students master critical reading of scientific papers. One credit hour.

## **First Year—Semester II (Nine Credit Hours Total)**

**Intro to Biostatistics, BTEC 560** An introduction to principles in statistics applicable to biotechnology. Two credit hour.

**Seminar II, BTEC 592.** This will be an introduction of seminar course. Each graduate faculty will present their work and foci of interest to the graduate students so they become familiar with the fields of research each faculty is involved. This will serve as a vehicle for the students to choose a mentor. One credit hour.

**Biotechnology II—Protein Structure & Function, BTEC 502.**  
**Prerequisite: BTEC 501** Basics of protein structure from amino acid composition to tertiary structure and oligomerization. Topics include: protein folds & molecular modeling, protein ensembles and dynamics, the Boltzmann equation, the unfolded state, protein folding and molecular origins of protein stability, catalysis, transition state theory, binding, organic and enzymatic reaction mechanisms, co-factors and redox reactions, steady state and pre-steady state enzyme kinetics, phylogenetics, protein relatedness, evolution of protein structure, mutation, adaptation, and structure-function relationships. Three credit hours

**Immunology & Pathobiology, BTEC 521.** Advanced coverage of topics to include: molecular basis of generation of diversity, antigen recognition, cytokines and chemokines biology, xenotransplantation, vaccination, evolution of immune system, allergies and therapeutics, gene therapy, immunodeficiency. Introduction of Pathobiology that will cover an array of diseases in a systematic fashion. Mechanism of disease will be presented along with basic concepts of pathobiology.

This course will prepare students for future professional careers in biotechnology related fields, including Biomedical Research, Forensics Research, Pharmacology, Genetic Engineering, Recombinant DNA Technology, as well as other biomedical fields. Three credit hours.

## **Summer.**

**Research I, BTEC 599.** Mentored original research in molecular biotechnology, plant biotechnology or bioinformatics toward production of a master's thesis. One credit hour.

## **Second Year Semester I:**

**Seminar III, BTEC 691.** Thesis draft preparation. Instruction in writing, organization, and presentation of master's thesis. Presentation of research to junior seminar class. One credit hour.

**Research II, BTEC 698.** Mentored original research in molecular biotechnology, plant biotechnology or bioinformatics toward the production of a master's thesis. Three credit hours.

### **Forensic Biotechnology Track**

**Introduction to Forensics, BTEC 610.** Instruction in DNA fingerprinting, paternity identification, mitochondrial sequencing, Restriction Fragment Length Polymorphism analysis, Polymerase Chain Reaction, HLA-DQA1, DNA databases searches, forensic laws. Three credit hours.

### **Plant Biotechnology Track**

**Plant Tissue Culture, propagation and transformation, BTEC 640.** Methods and research applications of plant tissue culture followed by principles and methods of in vitro plant propagation and transformation. Current advancement on the following topics will be covered in the course: plant tissue culture laboratory methods including media preparation and general lab practices; in vitro clonal propagation methods such as micropropagation, organogenesis and somatic embryogenesis for germplasm conservation and commercial scale production; crop improvement via doubled haploid breeding, protoplast technology and genetic engineering. This course will prepare students for future careers in plant biotechnology areas. Three credit hours.

### **Computational Biology/Bioinformatics Track**

**Bioinformatics, BTEC 620.** Introduction to single and multiple sequence alignment algorithms, origin and development of scoring matrices, phylogenetics algorithms, bootstrapping, tree building, and critical tree evaluation. Application of bioinformatics methods in secondary and tertiary structure prediction, homology modeling, and ab initio protein folding. Three credit hours.

**Special Topic in Graduate Biotechnology 690:** A specialization course to be taught by each mentor to their respective student/s so they become thoroughly specialized in the areas of their respective research. Two credit hours.

## **Second Year Semester II:**

**Seminar IV. BTEC 692.** On alternating weeks, instruction and practice in preparation of industry, professional, and graduate school applications. Every other week, invited speakers from the Special Topics in Biotechnology Seminar Series. One credit hour.

**Research III, BTEC 699.** Mentored original research in molecular biotechnology, plant biotechnology or bioinformatics, culminating with the production of a master's thesis. Two credit hours.

## **Forensic Biotechnology Track:**

**Forensic DNA Analyses, BTEC 611.** Instruction in DNA fingerprinting, paternity identification, mitochondrial sequencing, Restriction Fragment Length Polymorphism analysis, Polymerase Chain Reaction, HLA-DQA1, DNA databases searches, Forensic laws. Three credit hours.

## **Plant Biotechnology Track:**

**Plant Biotechnology, BTEC 650.** Methods and research applications of plant biotechnology followed by genetic manipulation of plants. Students will gain advanced knowledge on plant biotechnology techniques and tools that can be applied for the following: to develop and improve plant biotechnology products; for improving quantity and quality of food, feed, fiber and renewable energy needs; the use of transgenic plants as bioreactors to produce pharmaceuticals such as vaccines and therapeutic proteins; and to clean environmental pollutants to provide healthy living environment. This course will also provide sound knowledge of genetically modified organisms (GMO) with reference to the legislative framework and economic, social, moral and ethical issues, thereby further preparing students for productive careers in the plant biotechnological sciences. Three credit hours

## **Computational Biology/Bioinformatics Track:**

**Advanced Computational Biology, BTEC 665.** Molecular modeling and its applications. Three credit hours.

**Thesis Preparation, BTEC 689:** Three credit hours.

**c. Good-Academic Standing**

Accepted degree seeking candidates must maintain a grade point average of 3.0 on a 4.0 scale and earn no more than one “C” in any course to remain in good academic standing. If the GPA falls below 3.0 **OR** two grades of “C” are earned at any time, the student will lose good academic standing and be dismissed from the program. Additionally, students must maintain grades “S” for satisfactory progress in all research courses.

**\*\*\*Note: Preliminary testing will be conducted for all entering first year students. If remediation is deemed necessary by the MS faculty committee in any particular area, then the student must “audit” the appropriate undergraduate course(s) recommended by the MS faculty committee.**

**d. Thesis Process**

Students must author, present publicly, publish and defend a master’s thesis describing an original research project. The guidelines for the thesis document will be provided by the Biology Department.

**Selection of Research Mentor**

During the first eight weeks of the first year, Graduate Faculty will present their research. Two weeks following these faculty presentations students will submit their top three choices for a research mentor via email to the Chair of the Biology Department. During this same two week period, students are expected to interview with each of their three potential mentors. Every attempt will be made to give students their first choice. Decisions will be made on the basis of lab funds/space availability. In cases where funds/space is limited preference will be given to those who have the highest aptitude for the selected field of research.

**Thesis Committee Selection**

Before the beginning of the second semester of the first year, students must select three(3) faculty members to serve on their Thesis Committee (two committee members must be chosen from the Graduate Faculty and one committee member may be from any other department with eligibility to teach at the Master’s degree level) in addition to their research mentor. The research mentor serves as the chair of the committee. This committee will serve for the final evaluation of the master’s thesis.

**Prospectus**

At the end of the first year, students must submit a research proposal/prospectus to their Thesis Committee describing the research that they will be undertaking for the summer, and final year.

### Thesis Defense

Students must present their research in a closed thesis defense with their Thesis Committee acting as the sole evaluators of the final thesis by **March 1<sup>st</sup>** followed by an open public forum before **April 15<sup>th</sup>**. No Thesis Defense can be scheduled until after all three committee meetings. Progress Reports must be signed by each Thesis Committee member following each committee meeting. Progress Reports with signatures must be submitted to the Administrative Assistant for the Biology Department. At the end of the final year, by **April 15<sup>th</sup>**, students must submit a final thesis in writing to their Thesis Committee.

**Please refer to the timeline below.**

### Projected Thesis Timeline:

Objective	Deadline
<b>Year One</b>	
Choose 3 potential mentor and interview each	<b>3<sup>rd</sup> Friday in October</b>
Assignment of Mentors	<b>Before October 31st</b>
Selection of Committee Members	<b>Before December 15th</b>
Literature Review	<b>Before January 31st</b>
Research Presentation	<b>Before January 31st</b>
Prospectus	<b>Before January 31st</b>
Research Plan	<b>Before January 31st</b>
1 <sup>st</sup> Committee Meeting (Progress Report)	<b>First week of June</b>
<b>Year Two</b>	
2 <sup>nd</sup> Committee Meeting (Progress Report)	<b>Last week of August</b>
3 <sup>rd</sup> Committee Meeting (Progress Report)	<b>2<sup>nd</sup> week of November</b>
Completion of research activities	<b>At the discretion of Mentor</b>
Initial draft of Thesis	<b>February 20th</b>
Projected Thesis Defense	<b>March 1st</b>
Projected Public Presentation	<b>Before April 15th</b>
Projected Final Draft of Thesis Submission	<b>April 15th</b>

**\* These objectives are integral components of the degree requirements.**

### e. Seminar Presentation

All M.S. students will be required to make one seminar presentation to the School of Natural Sciences and Mathematics during one of the regularly scheduled seminar periods.