

**Clafin University**  
**Department of Biology**  
**Programs for MS of Biotechnology**

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

Students must complete 16 credit hours in core courses, 10 credit hours in track-specific courses, 8 credit hours in faculty mentored research, and 4 credit hours in seminar for a total of 38 credit hours. Syllabi for these courses are included as Appendix VIII. The curricular order and a brief description of courses are specified below.

**First Year—Semester I**

**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

**Intro to Biostatistics, BTEC 560** An introduction to principles in statistics applicable to biotechnology. One 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

**Laboratory in Protein Engineering, BTEC 512.** Laboratory applications of theoretical concepts taught in BTEC 502. Allows hands-on integration of diverse biotechnical applications to answer research questions *via* laboratory investigation. LAB TECHNIQUES INCLUDE: protein expression, purification, directed evolution of protein function, and characterization of enzymatic properties. One credit hour.

**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.

**Introduction to Biostatistics 560:** An introductory course on statistical methods and their application in biological field. One credit hour.

**Summer.**

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

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

### **Molecular Biotechnology Track**

**Cell Culture, BTEC X.** Introduction to biological molecules using cell culture technologies. Introduction to bioreactor design and control, molecular and cellular bioseparations, and tissue and cellular engineering. TOPICS INCLUDE: drug discovery, elements of pharmaceutical patent law, design of clinical trials, and the FDA approval process. Introduction to and practical aspects of clinical pharmacology. Three credit hours.

### **Forensic Biotechnology Track**

**Introduction to Forensics, BTEC 641.** 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 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 689:** 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 II, BTEC 699.** Mentored original research in molecular biotechnology, plant biotechnology or bioinformatics, culminating with the production of a master's thesis. Three 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 hours

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

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

**Thesis Preparation: Two credit hours.**

**d. Good-Academic Standing**

Accepted degree seeking candidates must maintain a grade point average of 3.0 on a 4.0 scale to remain in good-academic standing. In addition, students who earn more than two grades (six hours) of “C” during their coursework will lose good-standing and be dismissed from the program. **THERE’S NO PROBATION?** Additionally, students must maintain grades of “S” for satisfactory progress in all research courses.

**f. 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**

At the end of their first semester, students will submit their top three choices for a research mentor. 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 space/funds are limited preference will be given to those who have the highest aptitude for the selected field of research.

**Thesis Committee Selection**

By the end of the first year, student must select and gain the acceptance of two master’s student faculty to sit on their Thesis Committee 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**

At the end of the final year, by **March 1<sup>st</sup>**, students must submit a final thesis in writing to their Thesis Committee. Students then must present their research in an open public forum followed by a closed thesis defense with the student’s Thesis Committee acting as the sole evaluators of the final thesis by March 15<sup>th</sup>.

**g. 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.

**h. Graduation**

When a student has completed all coursework at a satisfactory level (refer to Good-Standing above) and has successfully defended and published his/her thesis as evidenced by the affixed signatures of the student’s Thesis Committee, the student will be recommended to the University faculty for graduation.

**i. Transfer Credits**

The School of Natural Sciences and Mathematics does not accept graduate transfer credits for our M.S. in Biotechnology Degree.

**j. Non-Degree Applicants**

Persons who wish to enroll in graduate coursework but who do not wish to pursue the M.S. degree may do so under the conditions described below. Such applications should not be made with the Degree Application form but should, instead, use the “Application for Non-Degree Enrollment.”