Biological Informatics

Professor Ronald K. Chesser, Director
Horn Professors Robert J. Baker, Clyde F. Martin; Professors Linda J. Allen, Randy Allen, Daniel Cooke, Gary F. Edson, Nick C. Parker, Carleton J. Phillips II; Associate Professors Robert D. Bradley, Jeffrey A. Lee; Assistant Professor: Kevin R. Mulligan.

Informatics is an emerging field that combines biological information with geographical, climatological, health related, and socioeconomic databases to provide a framework for understanding biocomplexity within the context of significant scientific, societal, and economic issues. Biological Informatics is a systems approach that allows for retrospective analysis of past events, real-time analysis of complex contemporary data sets, and, ideally, positioning for an unpredictable future. Biological Informatics is seen to encompass the rapidly growing field of BioInformatics, which is the computer-aided research/evaluation in genomics, proteomics, and DNA sequencing technologies.

The purpose of the proposed Master of Science degree program in Biological Informatics is to provide an academic structure through which students receive formal classroom education and strong guidance in information storage, curation, analysis and retrieval. Students will become familiar with several biological databases, as well as the use of Geographic Information Systems (GIS) and the linkage of GIS and biological databases (e.g., agricultural, biodiversity, demographic, epidemiology, biocomplexity and functional genomics databases). Students may choose one of three degree plans: a thesis option (32 hours required), an internship option (32 hours required), or a non-thesis option (38 hours required).

The thesis option is designed for students who plan to employ Biological Informatics in research programs and/or plan to continue their education in pursuit of a doctorate degree in a related field. The thesis option will include a written report of their research and the thesis will be in compliance with Texas Tech University standards. Procedures for completing the requirements for a Master’s thesis shall comply with those of the students home department. Students in the thesis option are required to complete 32 hours of course work, including 6 hours credit for a master’s thesis.

The internship option is for students whose goals are to apply Biological Informatics in the employ of specific businesses or industries. Students who choose this option must establish a relationship with a company such that Biological Informatics applications will be developed and used during their employment. The internship must be approved by the student’s advisory committee. The advisory committee must receive a written report of the student’s involvement with Biological Informatics from the student and from a responsible party in the cooperating business. The Internship may be for one semester (6 hours credit) or for two semesters (12 hours credit). Students in the internship option are required to complete 32 hours of course work, including credit for internship experience.

The non-thesis option is designed for students who wish to engage a broad curriculum in Biological Informatics without specifying a specific direction for in-depth research or application to businesses and industry. Students selecting this option will not be permitted to apply internship or thesis hours towards their degree. The student is required to have a major advisor and two committee members who select and approve the
non-thesis curriculum for the student. Students selecting the non-thesis “report” option are required to complete 38 hours of course work, including 3 hours credit for a research report.

Students who have been awarded any baccalaureate degree will be eligible to apply to the Biological Informatics Master’s program. Admission of students into the program would be based on scores (verbal, quantitative, and analytical) on the Graduate Record Exam (GRE), grade point average (GPA) for the last 60 hours for the undergraduate degree, and a written statement from the applicant outlining his or her educational goals. In order to be accepted into the program, the student must first be accepted for admission by the Graduate School and must receive a letter of acceptance from a preliminary advisor on the Biological Informatics program faculty. Students must meet or exceed the minimal requirements of the home department of their major advisor.

The curriculum will consist of a core of 18 hours and a set of electives. It should be noted that some required courses have prerequisites as noted. Students will be responsible for fulfilling the prerequisites. Students are required to write a thesis or a research report, depending upon their degree option.

Courses in Biological Informatics. (BINF)

BINF 5301 Introduction to BioInformatics (3:3:0). Provides an overview of the techniques for exploring databases for applications in genomics, proteomics, and other DNA/rNA technologies. The course will include discussions on ethics of human activities in DNA applications and research.

Core Courses. At least 18 hours are to be taken from the following areas.

CS 5301, 5302 Foundations of Computer Science I, II (3:3:0 each). An accelerated survey of computer science. Computer organization, high level and assembler languages, software design, data structures, file organization, machines, and formal languages. Prerequisite: Programming proficiency.

GEOG 5300 {or equivalent courses: GEOL 5428 - GIS in Natural Science and Engineering (4:3:3); RWFM 6305 - Geospatial technologies in Natural Resource Management (3:2:2)} Geographic Information Systems (3:2:3). Review of basic cartographic principles and the use of geographic information systems for thematic mapping and spatial analysis. Laboratory emphasis on experience with GIS software.

ISQS 6337 Business Programming Languages (3:3:0). Concepts of data structures and file processing as they relate to information systems. Emphasis on structured and object-oriented program design using C++. Prerequisite: ISQS 5341.


BIOL 6502 Biometry (5:4:3). The application of statistical methods to data from various fields of biological research. Special emphasis on conceptual bases of univariate
and multivariate tests from both parametric and nonparametric perspectives. Prerequisite: College Algebra.

**MATH 5354** Biomathematics I (3:3:0). Qualitative and quantitative behavior of deterministic biological models is studied. Prerequisite: Differential equations and linear algebra or consent of instructor.

*Elective Courses. Six to 12 hours, depending on the degree option, are to be taken from the following:*

- **GEOG 5301** Remote Sensing of the Environment (3:2:3). Review of remote sensing techniques, including air photo interpretation and digital satellite image processing. Emphasis on the use of remote sensing imagery in geographic information systems.

- **GEOG 5302** Advanced Geographic Information Systems (3:2:3). An advanced course in geographic information systems. Major topics include data acquisition, database management, and spatial analysis techniques. Laboratory emphasis experience with professional GIS software.

- **GEOL 5342** Spatial Data Analyses and Modeling in Geosciences (3:2:3). An advanced course in analysis of spatial patterns and applications of models to make predictions in spatial trends.

- **MATH 5355** Biomathematics II (3:3:0). Qualitative and quantitative behavior of stochastic biological models is studied. Statistics, differential equations and linear algebra or consent of instructor.

- **MATH 5356** Topics in Biomathematics (3:3:0). Current topics in biomathematics are studied such as biomechanics, mathematical epidemiology, mathematical neurology, mathematical ophthalmology, and image processing. May be repeated for credit. Prerequisite: Biomathematics II or consent of instructor.

- **ISQS 6339** Database Management Systems (3:3:0). Treatment of data as an organizational resource, objectives of data management, survey of commercial systems, data models, database design, client-server databases, object-oriented database design, and administration. Prerequisite: ISQS 6338.

- **MUSM 5327** Museum Collection Management (3:2:3). Defines the roles of museum collections and focuses on general museum concepts, procedures, and issues related to the management and care of collections. Instruction in art, humanities, and natural science collections. Prerequisite: MUSM 5321 or consent of instructor.

- **MUSM 5328** Museum Practicum (3:1:6). Individual instruction course of supervised experiences involving hands-on activities in museum administration, collections, education, and exhibitions. Sections will allow work in all areas of the Museum of Texas Tech. Prerequisite: consent of instructor.

- **MUSM 5330** Museum Law, Ethics, and Standards (3:3:0). Addresses the ethical considerations and legal obligations of museum collections, administration, and
operations. Attention given to international concerns as well as to state and national issues. Prerequisite: MUSM 5321 or consent of instructor.

**MUSM 5340**  **Museum Data Management (3:1:6).** Introduction of traditional and electronic management of museum collection data emphasizing the philosophy of data preservation and retrieval. Prerequisite: MUSM 5321 and MUSM 5327 or consent of instructor.

**PSS 6324.**  **Molecular Genetics and Plant Genomics (3:3:0).** Introduction to molecular methods and use of genomics in plant biology.