Intercollegiate Biomathematics Alliance

Graduate Certificate Programs in Mathematical Biology

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Programs Offered

Option I: IBA Online Certificate of Competency in Mathematical Biology

Option II: IBA Graduate Certificate in Mathematical Biology

Option III: IBA Accelerated Graduate Certificate in Mathematical Biology

Program Schedule

Fall Semester (14 weeks) *Start:* Last Monday of August

Spring Semester (14 weeks) *Start:* Second Monday of January

Summer Session (7 weeks) *Start:* First Monday of June

Program Requirements & Descriptions

All certificate program options require 15 credits of coursework to be completed with at least one course taken from each of the following areas of emphasis:

- mathematical modeling,
- data analysis,
- computer science,
- biological sciences.

Each course is worth 3 credits and is classified as either 500- or 600-level. All 500-level courses are online and offered directly from the IBA. All 600-level courses are offered through IBA member institutions' graduate coursework, where available. As such, credits earned at the 600-level may be transferable toward institutional post-graduate studies that lead to a post-graduate degree. Transferable credits earned in this option are subject to credit transfer rules of the graduate program to which they are applied.

Options I and II require a culminating experience in the form of a master's project, which serves as the fifth course of the program. Before beginning a culminating experience project, students must get approval in advance from a Graduate Advisor.

Option I. This is a self-paced program designed to allow students to complete a certificate by taking only 500-level online courses. Each online course must be completed within one year after registering for the course. The program must be completed within two years after registration. This 15-credit option has the following requirements:

- One course from each of the four areas of emphasis (total of 12 credits).
- Culminating experience project (3 credits).

Option II. This is a hybrid program designed to serve as a bridge to further academic studies and to allow for a portion of the coursework to be taken online. Each online course must be completed within one year after registering for the course. Students who successfully complete this option may receive higher priority for admission to the Biomathematics graduate program at Illinois State University. The program must be completed within two years after registration. This 15-credit option has the following requirements:

- One 600-level course from any two of the four areas of emphasis (total of 6 credits).
- One course from each of the two remaining areas of emphasis (total of 6 credits).
- Culminating experience project (3 credits).

Option III. This is an accelerated program designed to enable students who intend to continue to an institutional graduate program with the equivalent of one year's coursework credit. Students who successfully complete this program could then obtain an MS degree with only one additional year of post-graduate work at an institution that offers an MS in Mathematical Biology. Students who successfully complete this option may receive higher priority for admission to the Biomathematics graduate program at Illinois State University. This 15-credit option requires:

- One 600-level course from each of the four areas of emphasis (total of 12 credits).
- A second course from any of areas of emphasis (3 credits).

Tuition and Fees

All certificate programs require an application fee to start the program and a completion processing fee at the end. Each of the 500-level courses offered directly from the IBA will be charged per course. There may also be some additional fees (e.g., for textbooks) related to certain 500-level courses. Any 600-level courses taken at a member institution are subject to any applicable tuition and fees paid directly to the institution offering the course.

The cost breakdown varies depending on the membership status of the student as follows:

For students enrolled at an IBA institution:

- Program Application Fee: $25
- Course Fees:
  1. $90 per 500-level course taken directly from the IBA in addition to any textbook/material costs
  2. Any applicable tuition and fees for 600-level courses to be paid to the institution offering the course.
- Completion Processing Fee: $25

For students not enrolled at an IBA institution: Note that the higher application fee for non-IBA-institutional students includes a one-year individual IBA membership.

- Program Application Fee: $25
- Course Fees:
  1. $285 per 500-level course taken directly from the IBA in addition to any textbook/material costs
  2. Any applicable tuition and fees for 600-level courses to be paid to the institution offering the course.
- Completion Processing Fee: $25

Intercollegiate Biomathematics Alliance
Graduate Course Catalog

Courses are arranged by the four areas of emphasis: mathematical modeling, biological sciences, data analysis, and computer science. Those students completing a certificate in Option I or II will also need IBA 599 listed at the end under the heading "Culminating Project".

Mathematical Modeling

IBA 511 Differential Equations with Modeling (3 credits)

A modern study of differential equations including mathematical modeling and numerical solutions. Topics include the formulation of differential equations and interpretation of solutions, first-order linear and separable equations, dynamical systems approach to linear and nonlinear first order systems, numerical methods, and qualitative analysis. Applications and modeling of real world phenomena will be integrated throughout. Prerequisites: Calculus and Linear Algebra.

IBA 512 Applied Linear Algebra (3 credits)

A course in matrix and vector methods for studying systems of linear equations, with an emphasis on concrete calculations and applications. Specific topics to be covered include matrix algebra, linear systems of equations, vector spaces, linear dependence, rank of matrices, determinants, linear transformations, eigenvalues and eigenvectors, diagonalization, inner products and orthogonal vectors, and symmetric matrices. Computational tools will be integrated throughout the course to complement the mathematical content. Prerequisite: Calculus.

IBA 513 Discrete Mathematics with Applications (3 credits)

Introduction to basic techniques and modes of reasoning for discrete problem solving. Set theory, recurrence relations, counting, graphs and lattices, number theory. Prerequisite: Calculus

IBA 610 Mathematical Modeling (3 credits)

See the institutional course catalog for courses that may be substituted for IBA 610 credit.

Biological Sciences

IBA 521 Modern Biology, Dynamics of Life (3 credits)

Introduction to structure and function of the major groups of microorganisms, plants, and animals, emphasizing evolutionary relationships among the major groups. Introduction to molecules, processes, and cellular organization of living organisms.

IBA 522 Ecology (3 credits)

A study of interactions that determine the distribution and abundance of living organisms. The basic principles of ecology are presented in order to develop an understanding of the nature of these interactions at the individual, population, and community levels of biological organization. Prerequisite: Introductory Biology.

IBA 523 Environmental Science (3 credits)

Introduction to the relationship of humans and the environment. Selected aspects of current thinking and research concerning the impact of industrialization and urbanization on environmental quality, including the population explosion; the potential decline of the affluent society by the depletion of natural resources; the pollution of air, land surface, and water; the public agencies and policies designated to solve environmental problems.

IBA 620 Biological Sciences (3 credits)

See the institutional course catalog for courses that may be substituted for IBA 620 credit.

Data Analysis

IBA 531 Mathematical Statistics for Scientists (3 credits)

Sample spaces, discrete and continuous random variables, probability functions, density, moment generating functions, important distributions. Multivariate distributions, Central Limit Theorem. Statistical estimation. Point and interval estimators. Consistency, unbiasedness, minimum variance. Hypothesis testing. Likelihood ratio tests. Regression, analysis of variance. Prerequisite: Calculus.

IBA 532 Statistics for Modeling (3 credits)

Choosing, fitting, assessing and using statistical models. Simple linear regression, multiple regression, analysis of variance, general linear models, logistic regression and discrete data analysis will provide the foundation for the course. Classical interference methods. Prerequisite: Elementary Statistics.

IBA 630 Data Analysis (3 credits)

See the institutional course catalog for courses that may be substituted for IBA 630 credit

Computer Science

IBA 541 Python with Applications (3 credits)

Basics of programming in a high level language. Control structures, functions, arrays, and pointers before objects and classes. The examples and problems used in this course are drawn from diverse scientific areas.

IBA 542 Problem Solving with C++ (3 credits)

Introduction to the C++ programming language and its subset, the C programming language. Program structure, blocks, storage types, console and file I/O, functions, arrays, strings, pointers, call-by-reference, call-by-value, and dynamic memory allocation will be discussed. The concept of classes will be introduced. This course is designed to teach students the C++ programming language and introductory and intermediate programming concepts with examples and applications using the C++ programming language.

IBA 543 Programming with Java (3 credits)

An introduction to programming using the Java programming language. Students will learn the fundamentals of Java. The focus is on developing high quality, working software that solves scientific problems.

IBA 640 Computer Science (3 credits)

See the institutional course catalog for courses that may be substituted for IBA 640 credit.

Culminating Project

(For students in Option I or II)

IBA 599 Culminating Experience Project (3 credits)

Capstone project integrating aspects from mathematical modeling, data analysis, computer science, and biological sciences. May involve replicating or extending results from primary literature. Prerequisites: IBA 51x, IBA 52x, IBA 53x, and IBA 54x.

Certification Grade Requirements for All Options

Students must complete all courses with a grade of C or higher. Cumulative grade point average upon program completion must be 3.00 or higher.

Credit by Examination

Students may receive credit for IBA 500-level courses by successfully passing a course-specific examination. These proctored exams are intended for students who have already taken the equivalent course at an accredited institution. A nominal fee for the Credit by Examination will apply. Contact your graduate advisor for more information.