

# Biomathematics (BMA)

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## **BMA 560/BIO 560 Population Ecology** (3 credit hours)

Dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, species interactions, community structure and ecological genetics. One semester of calculus and a junior/senior level ecology course are required.

Co-requisite: ST 511

*Typically offered in Spring only*

*This course is offered alternate odd years*

## **BMA 567 Modeling of Biological Systems** (4 credit hours)

An introduction to quantitative modeling in biology. Use of Forrester diagrams, probabilistic and deterministic description of dynamic processes, development of model equations, simulation methods and criteria for model evaluation. Examination of current literature dealing with application of models and simulation in biology. Individual and class modeling projects.

Prerequisite: MA 131

*This course is offered alternate years*

## **BMA 573/MA 573 Mathematical Modeling of Physical and Biological Processes I** (3 credit hours)

Introduction to model development for physical and biological applications. Mathematical and statistical aspects of parameter estimation. Compartmental analysis and conservation laws, heat transfer, and population and disease models. Analytic and numerical solution techniques and experimental validation of models. Knowledge of high-level programming languages required.

Prerequisite: MA 341 and knowledge of high-level programming language.

*Typically offered in Fall only*

## **BMA 574/MA 574 Mathematical Modeling of Physical and Biological Processes II** (3 credit hours)

Model development, using Newtonian and Hamiltonian principles, for acoustic and fluid applications, and structural systems including membranes, rods, beams, and shells. Fundamental aspects of electromagnetic theory. Analytic and numerical solution techniques and experimental validation of models.

Prerequisite: MA/BMA 573

*Typically offered in Spring only*

## **BMA 590 Special Topics** (1-6 credit hours)

Special topics in BMA.

*Typically offered in Fall, Spring, and Summer*

## **BMA 591 Special Topics** (1-6 credit hours)

Directed readings, problem sets, written and oral reports as dictated by need and interest of student, e.g., cellular, molecular and physiological modeling; new 500-level courses during the developmental phase.

*Typically offered in Fall, Spring, and Summer*

## **BMA 610 Special Topics** (1-6 credit hours)

Directed readings, problem sets, written and oral reports as dictated by need and interest of student, e.g., cellular, molecular and physiological modeling; new 500-level courses during the developmental phase.

*Typically offered in Fall, Spring, and Summer*

## **BMA 685 Master's Supervised Teaching** (1-3 credit hours)

Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student

*Typically offered in Fall, Spring, and Summer*

## **BMA 690 Master's Examination** (1-9 credit hours)

For students in non thesis master's programs who have completed all other requirements of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student

*Typically offered in Fall and Spring*

## **BMA 693 Master's Supervised Research** (1-9 credit hours)

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student

*Typically offered in Fall, Spring, and Summer*

## **BMA 695 Master's Thesis Research** (1-9 credit hours)

Thesis research.

Prerequisite: Master's student

*Typically offered in Fall and Spring*

## **BMA 696 Summer Thesis Research** (1 credit hours)

For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student

*Typically offered in Summer only*

## **BMA 699 Master's Thesis Preparation** (1-9 credit hours)

For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their theses.

Prerequisite: Master's student

*Typically offered in Spring and Summer*

## **BMA 771/MA 771/ST 771 Biomathematics I** (3 credit hours)

Role of theory construction and model building in development of experimental science. Historical development of mathematical theories and models for growth of one-species populations (logistic and off-shoots), including considerations of age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories of two and more species systems (predator-prey, competition, symbiosis; leading up to present-day research) and discussion of some similar models for chemical kinetics. Much emphasis on scrutiny of biological concepts as well as of mathematical structure of models in order to uncover both weak and strong points of models discussed. Mathematical treatment of differential equations in models stressing qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models.

Prerequisite: Advanced calculus, reasonable background in biology

*Typically offered in Fall only*

**BMA 772/MA 772/ST 772 Biomathematics II** (3 credit hours)

Continuation of topics of BMA 771. Some more advanced mathematical techniques concerning nonlinear differential equations of types encountered in BMA 771: several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology, some recent research.

Prerequisite: BMA 771, elementary probability theory

*Typically offered in Spring only*

**BMA 773/MA 773/OR 773/ST 773 Stochastic Modeling** (3 credit hours)

Survey of modeling approaches and analysis methods for data from continuous state random processes. Emphasis on differential and difference equations with noisy input. Doob-Meyer decomposition of process into its signal and noise components. Examples from biological and physical sciences, and engineering. Student project.

Prerequisite: BMA 772 or ST (MA) 746

*Typically offered in Spring only*

*This course is offered alternate years*

**BMA 774/OR 774/MA 774 Partial Differential Equation Modeling in Biology** (3 credit hours)

Modeling with and analysis of partial differential equations as applied to real problems in biology. Review of diffusion and conservation laws. Waves and pattern formation. Chemotaxis and other forms of cell and organism movement. Introduction to solid and fluid mechanics/dynamics. Introductory numerical methods. Scaling. Perturbations, Asymptotics, Cartesian, polar and spherical geometries. Case studies.

Prerequisite: BMA 771 or MA/OR 731; BMA 772 or MA 401 or MA 501

*Typically offered in Spring only*

**BMA 790 Special Topics** (1-6 credit hours)**BMA 801 Seminar** (1 credit hours)

Graduate students in biomathematics are expected to attend through most of their residence period.

Prerequisite: Graduate standing

*Typically offered in Fall and Spring*

**BMA 815 Advanced Special Topics** (1-6 credit hours)

Directed readings, problem sets, written and oral reports as dictated by need and interest of student; new 600-level courses during the development phase (currently includes courses in stochastic modeling and biophysical theory).

*Typically offered in Fall, Spring, and Summer*

**BMA 885 Doctoral Supervised Teaching** (1-3 credit hours)

Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**BMA 890 Doctoral Preliminary Exam** (1-9 credit hours)

For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**BMA 893 Doctoral Supervised Research** (1-9 credit hours)

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**BMA 895 Doctoral Dissertation Research** (1-9 credit hours)

Dissertation research

Prerequisite: Doctoral student

*Typically offered in Fall and Spring*

**BMA 896 Summer Dissertation Research** (1 credit hours)

For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student

*Typically offered in Summer only*

**BMA 899 Doctoral Dissertation Preparation** (1-9 credit hours)

For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*