Request for a New Course:

**Background information:** Drs. Koksal and Dshalalow (Mathematical Sciences); and Drs. van Woesik, Sinden and Carroll (Biological Sciences) have received an NSF grant titles “UBM-Group: Research and Education Program (REP) in BioMath” which started in Jan. 1, 2008. This project is to train undergraduate students from Mathematical and Biological Sciences Departments at the intersection of two disciplines. The students recruited from these departments will pursue cross disciplinary studies during their junior and senior years. Training will be through both classroom and inquiry-based research. As proposed to NSF, three new courses will be developed: **Primer for BioMath, Mathematical Methods for Biology and Ecology, and Biostochastics.** These courses will teach the students the different languages of mathematics and biology to facilitate cross disciplinary communication and equip them with an appropriate biological background and problem solving and modeling skills that ensure successful completion of cutting-edge interdisciplinary research. All three courses will be offered as electives to all interested students on campus and as **required electives to the UBM participants.**

The first course, “Primer for BioMath”, which has been approved in Fall is currently being taught and has 19 students (mostly sophomores from mathematical and biological sciences as well as dual majors). As the second course of the series, we plan to offer “Mathematical Methods for Biology and Ecology” in Fall 2008.

**Rationale:** Currently, the curriculum in applied mathematics as well as mathematical sciences does not have a course on mathematical biology (biomath). This course, being the first biomath course, will introduce mathematical techniques relevant to the problems of biology and ecology (for detail content information, please refer to course syllabus). It will provide the mathematical techniques and skills needed for the students to successfully conduct interdisciplinary research in mathematical biology.
MTH 3663  MATHEMATICAL METHODS
FOR BIOLOGY AND ECOLOGY

Instructors: Semen Koksal – Mathematical Sciences, Robert van Woesik, Richard
Sinden and David Carroll – Biological Sciences.

Text: No text book; please see the list of books given below for references.

Course Objectives: The main objective of the course is to study and analyze
mathematical models in biology and ecology. Selected topics from
linear algebra, numerical analysis and theory difference and
differential equations will be discussed and used in biological and
ecological applications.

The course will be supported by computer algebra systems (CAS)
such as Mathematica and MATLAB.

Prerequisites: The prerequisites for the course are Calculus II and Primer for
Biomath. A background in higher level mathematics, biology and
CAS is desirable but not required; the course is self-contained and
necessary information for CAS will be provided.

Course Content:

PART I: Linear Algebra (3 weeks)

0. Biological Motivation: Size-structured models, age-structured models of
population dynamics such as Leslie and Usher matrices; and microarrays for gene
expression.
1. Matrix Algebra
2. Special Matrices
3. Solving Linear Systems
4. Eigenvalues and Eigenvectors
5. Sensitivity analysis

PART II: Numerical Techniques (4 weeks)

0. Biological Motivation: Graphical and mathematical analysis of scientific data,
enzyme kinetics and defining ecological processes.
1. Library of Functions
2. Numerical Techniques for Solving Nonlinear Systems
3. Interpolation and Curve Fitting
4. Approximation Theory
5. Numerical Differential and Integration
PART III: Discrete and Continuous Dynamical Systems (7 weeks)

0. Biological Motivation: Mathematical models in discrete and continuous time at all spatial scales of biology from point mutations through evolution of populations.
1. Theory of Difference Equations
2. First Order Differential Equations
3. Systems of Differential Equations
5. Phase Plane and Stability Analysis
6. Bifurcation and Chaos Theory

Grading:

HW/Quizzes 30 %
Test 1 15 %
Test 2 15%
Final 40%

REFERENCES:

This course is available for student registration only after the approval process has been completed.

SUBJECT MTH COURSE NO. 3663 CREDIT HOURS 3 TERM TO BE ADDED TO THE FILE Fall 2008
Alpha Prefix (e.g., CSE) Number Choice (e.g., 1301) (e.g., Fall 2008)

CLASS HOURS LECTURE HOURS 3 LAB HOURS CONTACT HOURS (CEUONLY)

DEPARTMENT Mathematical Sciences SCHEDULE TYPE Lecture
(e.g., Computer Sciences) (e.g., Lecture, Lab or Special Project)

☐ COLLEGE OF AERONAUTICS-23 ☐ COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS-25
☐ COLLEGE OF BUSINESS-24 ☐ COLLEGE OF SCIENCE-26
☐ COLLEGE OF ENGINEERING-01 ☐ UNIVERSITY COLLEGE EXTENDED STUDIES-27

COMPUTER TITLE Restricted to 25 characters, including spaces Methods for Biomath

CATALOG TITLE Mathematical Methods for Biology and Ecology

CATALOG DESCRIPTION OF COURSE Limited to 350 characters, including spaces
Examines biological processes and mathematically reformulates the biological information into linear and nonlinear systems, differential equations and studies these formulations via matrix algebra, numerical techniques, approximation theory, stability and bifurcation analysis.

In addition, you may attach a course syllabus and/or more detailed description.

RESTRICTIONS ☐ Prerequisite MTH 1002 ☐ Corequisite Course Number
☐ Prerequisite MTH/BIO 2332 ☐ Corequisite Course Number
☐ Prerequisite Course Number ☐ Corequisite Course Number

GRADES TO BE ISSUED ☒ A, B, C, D, F
☐ A, B, C, D, F, CEU
☐ CEU
☐ S, U
☐ P, F
☐ Other

ADDITIONAL RESTRICTION junior level, by instructor's approval
(e.g., Major, Class Level, Department Head Approval)

If this course replaces a course currently offered in BANNER, please indicate old course information

SUBJECT Alpha Prefix (e.g., CSE) COURSE NO. (e.g., 1301)

APPROVALS: Upon completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee for approval below and forward to Catalog Director.

Author Originator Date Feb. 22, 2008

Chairs Graduate Council Date

Department Head/Program Chair 2/21/08 OR

Dean or Associate Dean Date

Chair, Undergraduate Curriculum Committee Date

CATALOG DIRECTOR

These changes/additions have been made for the University/Extended Studies Catalog and entered into the BANNER term named above.

Catalog Director Date

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