LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No.	UWUCC Action-Date:	Senate Action Date:
		03-43c	Appr 4/6/04	Appr 12/7/04

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person	Email Address
Gary Stoudt	gsstoudt@iup.edu
Proposing Department/Unit	**Phone**
Mathematics	7-2608

Check all appropriate lines and complete information as requested. Use a separate cover sheet for each course proposal and for each program proposal.

1. Course Proposals (check all that apply)

_____New Course _____Course Prefix Change _____Course Deletion

__X__Course Revision __X__Course Number and/or Title Change __X__Catalog Description Change

MATH 447 Simulation Models	MATH 447 Modeling and Simulation
***Current* Course prefix, number and full title**	***Proposed* course prefix, number and full title, if changing**

2. Additional Course Designations: check if appropriate

_____ This course is also proposed as a Liberal Studies Course.

_____ This course is also proposed as an Honors College Course.

_____ Other: (e.g., Women's Studies, Pan-African)

3. Program Proposals

_____Catalog Description Change _____Program Revision

_____New Degree Program _____Program Title Change _____Other

_____New Minor Program _____New Track

***Current* program name**	***Proposed* program name, if changing**

4. Approvals

		Date
Department Curriculum Committee Chair(s)	George E. Mitchell	11-24-03
Department Chair(s)	Gary Stoudt	11-24-03
College Curriculum Committee Chair		03/18/04
College Dean		3/8/04
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate:		
(include title)		
UWUCC Co-Chairs	Gail Sahrist	4-6-04

* where applicable

MAR 19 2004 LIBERAL STUDIES

APR 13 2004 LIBERAL STUDIES

1. New Syllabus of Record

I. Catalog Description

MATH 447 Modeling and Simulation	3 class hours 0 lab hours
Prerequisites: MATH 122 or 124; MATH 171; MATH 216	3 credits (3c-0l-3cr)

Construction and solution of mathematical models. Emphasis is on applications in areas such as logistics, natural and social sciences, and manufacturing. Discrete and continuous system models are analyzed using mathematical and computer-based methods. Introduction to computer simulation. An introductory course in differential equations is recommended but not required.

II. Course Objectives

Students will be able to:
1. know the methodology for converting real problems into mathematical models,
2. apply various mathematical tools to analyze mathematical models,
3. understand and develop simple computer simulations.

III. Course Outline

1. Introduction to Modeling (2 hours)
    - A. The modeling process
    - B. Deterministic vs. probabilistic models
    - C. Continuous event vs. discrete event models

2. Deterministic Models
    - A. Mechanical vibrations (6 hours)
        1. Spring-Mass systems
        2. Pendulum
        3. Phase plane analysis
    - B. Population Dynamics, Mathematical Ecology (9 hours)
        1. Discrete one-species models
        2. Discrete two-species models
        3. Continuous one and two-species models
        4. Phase plane analysis
    - C. Traffic Flow (12 hours)
        1. Traffic flow, density and conservation
        2. Velocity-density relationship
        3. Partial differential equation of motion
        4. Method of characteristics
        4. Traffic density waves and shock formation

3. Probabilistic models (10 hours)
    - A. Probabilistic events
        1. Review of probability distributions
        2. Pseudorandom number generators
    - B. Modeling & Simulation of events

1. Simulating discrete probabilistic models
2. Queuing models
3. Simulation of queues

4. Additional time for Examinations and review (3 hours)

Final Exam—During Final Exam Week.

IV. Evaluation Methods

Evaluation for the course will typically consist of the following:

Written homework	20%
Three Exams	45%
Projects	20%
Final Exam	15%

Grading Scale: A: 90-100%; B: 80-89%; C: 70-79%; D: 60-69%; F: below 60%

V. Attendance Policy

The course attendance policy will be consistent with University policy.

VI. Required Textbooks, Supplemental Books and Readings

Instructor course packet.

VII. Special Resource Requirements

None.

VIII. Bibliography

Atkinson, K.E. An Introduction to Numerical Analysis, 2nd Ed., John Wiley & Sons, 1989.

Beltrami, Edward, *Mathematics for Dynamic Modeling*, 2nd Edition, Academic Press 1998.

Bossel, Hartmut. *Modeling and Simulation*, A. K. Peters, 1994.

Burghes, D. N., Ian Huntley, and John McDonald. *Applying Mathematics: A Course in Mathematical Modelling*, Halsted Press, 1982.

Fulford, Glenn, et al. *Modelling with Differential and Difference Equations*, Cambridge University Press, 1997.

Giordano, Frank, et al. *A First Course in Mathematical Modeling, 3rd Edition*, Thomson, Brooks/Cole, 2003.
Haberman, Richard. *Mathematical Models Mechanical Vibrations, Populations Dynamics and Traffic Flow*, SIAM, 1998.

Meerschaert, Mark, Mathematical Modeling, Academic Press, 1999.

Mesterson-Gibbons, Michael. *A Concrete Approach to Mathematical Modelling*, Wiley, 1995.

Meyer, Walter J. *Concepts of Mathematical Modeling*, McGraw-Hill, 1984.

Pritsker, A. Alan B., Jean J. O'Reilly, and David K. LaVal. *Simulation with Visual SLAM and AWESIM*, John Wiley and Sons, 1999.

2. Summary of Revisions

The course had an emphasis on the SLAM II simulation software, which is obsolete. This course will still use some simulation software, but more emphasis is given to mathematical modeling. The new course title and description reflect this change.

MATH 122 and MATH 124 are the terminal courses in the two semester sequence of calculus at IUP, so this change formalizes the calculus prerequisite. MATH 216 is the introductory course in probability and statistics for natural sciences, formalizing the probability and statistics prerequisite. MATH 171 is an introductory course in linear algebra (matrices, etc.) Matrix techniques are essential in solving modeling problems.

3. Justification/Rationale for the Revision

This is a modernization of the course to use more current technology and to shift some of the course emphasis from simulation to modeling. Mathematical modeling is an important and fundamental skill for quantitative problem solvers. Mathematical modeling is the process of formulating and solving real-world quantitative problems using mathematics. In performing this process, we normally need to describe a real-world phenomenon or behavior in mathematical terms. Often, the problem solver is interested in understanding how a system works, the cause of its behavior, the sensitivity of the process to changes, predicting what will happen, or making a decision based on the mathematical model developed. It is natural that the Mathematics Department should have such a course.

4. Old Syllabus of Record

Next page.

Mathematics Department
Indiana University of Pennsylvania
Indiana, PA 15705

Course Number: MA 447 or MA 557

Course Title: Simulation Models

Credits: 3 semester hours

Prerequisites: Completion of the calculus sequence; background in statistics and probability, and familiarity with concepts of programming (Knowledge of a particular programming language not required.)

Textbook:

Catalog Description:
This course considers the types of models that are basic to any simulation and methods for building and using such models. It includes discrete and continuous system simulations, their applications, and an introduction to SLAM II (Simulation Language for Alternative Modeling).

Course Outline/Time Schedule:

A. INTRODUCTION TO BASIC CONCEPTS AND TERMINOLOGY
   1. Concepts of a System
   2. System Methodology
   3. Advantages/disadvantages of simulation
   4. Simulation of a Bank Teller

B. BRIEF REVIEW OF IMPORTANT CONCEPTS OF PROBABILITY AND STATISTICS
   1. Experiment, Sample Space and Outcomes
   2. Probability
   3. Random Variables and probability Distribution
   4. Statistical Inference
   5. Hypothesis Testing
   6. Class presentation of group problems

C. GENERATION OF RANDOM NUMBERS
   1. Pseudorandom numbers
   2. Algorithms for generating pseudorandom numbers
   3. Testing and validating pseudorandom numbers
   4. Generation of nonuniform variates
   5. Class presentation of group problems

D. NETWORK SIMULATION
   1. Modeling world views
   2. Discrete simulation modeling
   3. Continuous simulation modeling

4. Combined discrete-continuous modeling
5. SLAM II - a unified modeling framework
6. Case studies in simulation
7. Introduction to the use of SLAM II: input and output

E. DISCRETE AND CONTINUOUS SYSTEM SIMULATION
1. Introduction to the network representation of simulation models
2. Introduction to the basic SLAM II statements use to define the simulation models
3. Case studies using the network representation
4. Class presentation of group problems

F. INTRODUCTION TO SLAM II
1. Introduction to resources and gates
2. Logic and decision nodes
3. Case studies using advanced network modeling
4. Class presentation of group problems

G. NETWORK MODELING WITH USER-WRITTEN INSERTS
1. Introduction to user-written inserts for initializing and post-run processing routines; resource allocation procedures; queue sections; server sections; stopping an activity
2. Case studies using user-written inserts
3. Class presentation of group problems

H. DISCRETE EVENT MODELING AND SIMULATION
1. Discrete event orientation
2. Scheduling events
3. File manipulation and statistics collection
4. Input statements and output reports
5. Case studies using discrete event modeling
6. Class presentation of group presentation

I. CONTINUOUS MODELING
1. Introduction to continuous modeling
2. Collecting time-persistent statistics on state variables
3. Simultaneous state-events
4. Modeling using state variables
5. Modeling using derivatives of state variables
6. Time advance procedures
7. Case studies using continuous models
8. Class presentation of group problems

J. COMBINED MODELING
1. Introduction to combined modeling
2. Using alternate modeling viewpoints
3. Case studies using combined modeling
4. Class presentation of group problems

K. SIMULATION LANGUAGES
1. Brief introduction to other simulation languages;• comparison/contrast: GPSS, SIMSCRIPT II

L. STATISTICAL ASPECTS OF SIMULATION
1. Statistical questions facing simulators
2. Importance of the variance of the sample mean
3. Procedures for estimating variance
4. Start-up policies
5. Stopping rules
6. Design of experiments

Note: Students will also be required to:

1) complete a project related to simulation models;
2) read and submit brief reports on two articles in the literature;
3) take an in-class final exam using SLAM II which involve representing a system by a simulation model and solving that model.

Bibliography

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Duket, S. and C.R. Standridge, "Application of Simulation: Combined Models," Modeling, The Simulation Technical Committee Newsletter (IEEE), No. 19, Dec. 1983.

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Erdbruegger, D.D., W.G. Parmelee and D.W. Starks, "SLAM II Model of the Rose Bowl Staffing Plans," Proceedings, 1982 Winter Simulation Conference, 1982, pp. 127-135.

Jayakumar, M.S. and T.M. McCalla, Jr., "Simulation of Microprocessor Emulation Using GASP_PL/I," Computer, April 1977, pp. 20-26.

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Musselman, K.J., "Computer Simulation: A Design Tool for FMS," Manufacturing Engineering, Vol. 93, 1984, pp. 117-120.

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Standridge, C., C. Macal, A. Pritsker, H. Delcher, and R. Murray, "A Simulation Model of the Primary Health Care System of Indiana," Proceedings, 1977 Winter Simulation Conference, 1977, pp. 349-358.

Waugh, R.M. and R.A. Andener, "Simulation of an Automated Stacker Storage System," Proceedings, 1977 Winter Simulation Conference, 1977, pp. 769-776.