88-89/108

INDIANA UNIVERSITY OF PENNSYLVANIA
SENATE CURRICULUM COMMITTEE B-2

NEW COURSE PROPOSAL

Department: Mathematics

Person to Contact for Further Information: Dr. Joseph Angelo

Course Affected: MA 447 Simulation Models (New Course)

Desired Effective Semester for Change: Spring '88

Approvals: Department Committee Chairperson Ronald L McBride

Department Chairperson John Broughton

College Committee Chairperson C K Fuegy

College Dean C K Fuegy

A. DESCRIPTION AND ACADEMIC NEED

A1. Catalog description attached.

A2. Course syllabus and bibliography attached.

A3. This course will serve as an elective course for students with an undergraduate emphasis in applied mathematics. As a dual level course, it will also be an elective for graduate students in the M.S. program who have not taken a simulation models course as an undergraduate. The course would also be suitable for computer science majors, or science majors, or even business majors who have a suitable mathematics background, or who wish to pursue an applied mathematics minor. It is not proposed for inclusion on the regular General Education course list.

A4. This course does not require changes in content of other existing courses.

A5. Traditional format will be used in the presentation of material.

A6. The course has been offered successfully as a Special Topics course both in the summer and during the regular semester. It has attracted students from other disciplines. Joseph Peters of the Mathematics Department has served as the instructor each time it has been offered.

A7. The course will be offered as a dual level course as noted in A3. The proposal is currently proceeding through the approval process. It has been approved by the Mathematics Department Faculty, and is ready for submission to the College Dean and the Graduate Committee of the Senate.

A8. Catalogs for several universities in a comparison group for IUP were examined. Included were catalogs for Clarion, Indiana State University, Marshall, Millersville, University of Pittsburgh, Penn State, Sam Houston, Shippensburg, West Chester University, Western Illinois, and West Virginia. Of those examined, only the following catalogs revealed similar courses:

West Chester University - CSC 561, Simulation, and MAT 570, Mathematical Models in the Life, Physical, and Social Sciences. (Proposed course is a combination of these courses, both dual level.)

Western Illinois - Course number 486G, Simulation (dual level)

A9. Proposed course is not specifically recommended by a professional society, accrediting authority, law, or external agency; however it is a course of the type recommended by our external evaluators, Lightner and Merserve, especially with regard to the graduate program.

B. INTERDISCIPLINARY IMPLICATIONS

B1. The course will be taught by one instructor.

B2. No additional or corollary courses needed now or later.

B3. There is no relationship between this course and courses offered by other departments; however, the course was discussed with the Computer Science Department at the time it was offered as a Special Topics course. The proposal has been reviewed by the Computer Science Department (memorandum attached).

B4. Course is probably not applicable to a program in the School of Continuing Education.

C. EVALUATION

C1. Examinations will be used to evaluate student progress.

C2. The course may not be taken for variable credit.

D. IMPLEMENTATION

D1. a. Faculty currently available.

b. There is sufficient space and equipment.

c. No laboratory supplies are required.

d. Library resources are adequate.

e. No travel funds required.

D2. This course will be offered at least once per year.

D3. There will probably be just one section each time the course is offered.

D4. Class size should not exceed 20 so that each student can receive appropriate attention from the instructor.

Catalog Description

MA 447 SIMULATION MODELS 3 s.h.

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

MA 447 SIMULATION MODELS

DESCRIPTION

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OUTLINE — Number of Periods

A. INTRODUCTION TO BASIC CONCEPTS AND TERMINOLOGY — 1
   1. Concept 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 — 2
   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 — 3
   1. Pseudorandom numbers
   2. Algorithms for generating pseudorandom numbers
   3. Testing and validating pseudorandom numbers
   4. Generation fo nonuniform variates
   5. Class presentation of group problems

D. NETWORK SIMULATION — 3
   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 — 6
   1. Introduction to the network representation of simulation models.
   2. Introduction to the basic SLAM II statements used to define the simulation models.
   3. Case studies using the network representation.
   4. Class presentation of group problems

Number of Periods

F. INTRODUCTION TO SLAM II — 3
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 — 3
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 — 6
1. Discrete event orientation
2. Scheduling events
3. File manipulations and statistics collection
4. Input statements and output reports.
5. Case studies using discrete event modeling
6. Class presentation of group problems

I. CONTINUOUS MODELING — 6
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 — 5
1. Introduction to combined modeling
2. Using alternative modeling viewpoints
3. Case studies using combined modeling
4. Class presentation of group problems

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

L. STATISTICAL ASPECTS OF SIMULATION — 3
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

Total: 42

Note: Students will also be required to:

1) completed 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 will involve representing a system by a simulation model and solving that model.

Bibliography

Allessandra, A.J., T.E. Grazman, R. Parameswaran, and U. Yavas, "Using Simulation in Hospital Planning," Simulation, Vol. 30, 1978, pp. 62-67.

Banks, J. and J.S. Carson, II, Discrete-Event System Simulation, Prentice-Hall, 1984.

Cellier, F.E., Ed., Progress in Modelling and Simulation, Academic Press, 1982.

Deporter, E.L., H.A. Kurstedt, Jr., and J.A. Nachlas, "A Combined Simulation Model of the Nuclear Fuel Cycle," Proceedings, 1977 Winter Simulation Conference, 1977, pp. 213-216.

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

Dumas, m.B. and M. Rabinowitz, "Policies for Reducing Blood Wastage in Hospital Blood Banks," Management Science, Vol. 23, 1977, pp. 1124-1132.

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.

Law, A.M. and W.D. Kelton, Simulation Modeling and Analysis, McGraw-Hill, 1982.

Lilegdon, W.R., C.H. Kimpel and D.H. Turner, "Application of Simulation and Zero-One Programming for Analysis of Numerically Controlled Machining Operations in the Aerospace Industry," Proceedings, 1982 Winter Simulation Conference, 1982, pp. 281-289.

Mihram, G.A., Simulation: Statistical Foundations and Methodology, Academic Press, 1972.

Moder, J.J. and S.E. Elmaghraby, Handbook of Operations Research: Models and Applications, Van Nostrand Reinhold, 1978.

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

Naylor, T.H., Computer Simulation Experiments with Models of Economic Systems, Wiley, 1971.

Pritsker, A.A.B., and C. Elliott Sigal, Management Decision Making: A Network Simulation Approach, Prentice-Hall, 1983.

Shannon, R.E., Systems Simulation: The Art and Science, Prentice-Hall, 1975.

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. Ankener, "Simulation of an Automated Stacker Storage System," Proceedings, 1977 Winter Simulation Conference, 1977, pp. 769-776.

INDIANA UNIVERSITY OF PENNSYLVANIA • INDIANA, PENNSYLVANIA 15705
Department of Mathematics • 233 Stright Hall • (412) 357-2608

Date: March 23, 1987

To: Tom Cunningham, Chairperson
Computer Science Department

From: Joe Angelo

Subject: New Course Proposal (Simulation Models)

A few semesters ago we offered a course, Simulation Models, as a Special Topics course. At that time, we discussed the course with your department to determine if there was any overlap with content of your courses. There was none at that time.

Now, we are formally proposing Simulation Models as a dual level course and are attempting to have it officially approved by the Curriculum and Graduate Committees of the Senate.

I have attached an outline and catalog description of the course as we intend to submit it to the Senate Committees. Please let me know (via memo) if there is any relationship between the content of this course and the content of courses which are offered by the Computer Science Department. If so, we will need your department's approval before we can proceed.

Let me know if there are any problems or if you have any questions. This course was conceived by and has been taught by Joe Peters; so he should also be consulted if there are questions.

Thanks.

Indiana University of Pennsylvania
Computer Science Department

May 6, 1987

SUBJECT: Simulation Models Course

TO: Dr. Joe Angelo
Mathematics Department

FROM: Mr. Gary L. Buterbaugh, Chairman
Computer Science Department

This memo is intended to serve as the Computer Science Department's response to your proposal to offer a course in Simulation Models (the Graduate Number is MA 547 - nothing is said in the proposal which we received about the undergraduate component) for 3 s.h. We need to respond in two parts. The first concerning the graduate course and, the second, the undergraduate one.

Since we have no graduate program, and there is currently none in our plans, we have no interest in teaching any graduate course; and, therefore, we have no objection to your offering a graduate course in Simulation Models.

We would, however, like to request that the undergraduate course be cross linked with our department. This course is one normally included as a senior elective in the computer science program and taught by computer science faculty. Since we have no faculty currently interested in teaching (or dividing) such a course, we have no problem with Joe Peters teaching it. We would like to have a copy of your undergraduate course proposal so we can develop one like it and can then submit it jointly with yours.

Sorry it took so long to get this memo to you. If you have any questions, please contact me. Thanks.

GLB/cam

Date: May 27, 1987

To: Gary Buterbaugh, Chairman
Computer Science Department

From: Joe Angelo, Director of Graduate Studies
Mathematics Department

Subject: Simulation Models Course

Thank you for your May 6, 1987 memo in which you state no objection to our offering a graduate course in Simulation Models. We would like to offer the course, MA 547 Simulation Models, as a dual level course with undergraduate number, MA 447. We have no objection to cross listing the course with your department and sharing the teaching of the course with qualified and interested members of your faculty.

I have attached a copy of the undergraduate course proposal. If everything is satisfactory, I would appreciate a written memo from you as soon as possible so that we can move the course through the approval procedure.

Thanks, Gary.

INDIANA UNIVERSITY OF PENNSYLVANIA • INDIANA, PENNSYLVANIA 15705
Department of Computer Science • 319 Stright Hall • 412-357-2524

Date: October 7, 1987

To: Joe Angelo
Mathematics Department

From: Tom Cunningham, Chairman T.P.C.
Computer Science Department

Subject: Proposed Course in Simulation Models.

The Computer Science Department has no objection to the Mathematics Department's offering of the course MA 447 as a dual level course, provided it is cross listed with the Computer Science Department and the teaching of the course is shared with our department when qualified and interested faculty are available to teach it. The department teaching the course could be determined on a pro rata basis according to the majors of the students enrolled in the course.

It is possible that the Computer Science Department at a later date would be interested in offering its own course in simulation models, real time processing and/or parallel processing which would emphasize the language development and programming as opposed to your course which emphasizes the modeling and the applications of simulation in problem solving.