

CURRICULUM PROPOSAL FORM 2000-2001

1703-411

**NON-GENERAL EDUCATION PROCESS A**

**\*DEADLINES:** Deadline dates for 2000/2001 submissions: Regular proposals: October 20, 2000 to be implemented in Fall 2001; Short-Term proposals: December 8, 2000 to be implemented in Fall, 2001; Regular proposals February 16, 2001 to be implemented in Spring, 2002; March 23, 2000 for short-term courses to be implemented in Spring 2002.

**PROPOSAL TITLE:** Deterministic Models in Operations Research

**SPONSOR(S):** Dr. Christopher Lacke

**DEPARTMENT:** Mathematics

**COLLEGE:** College of Liberal Arts & Sciences

**IF LAS CHECK ONE:**  History/Humanities  Math/Sciences  Social/Behavioral Sciences

**Check one:**  Undergraduate  Graduate

THE ATTACHED **NON-GEN-ED** PROPOSAL IS BEST DESCRIBED BY THE ITEM(S) CHECKED.

- New non-gen-ed course
- Short-term non-gen-ed course
- Minor curricular changes (fewer than three) to:
  - existing non-gen-ed course
  - non-gen-ed degree requirements
  - major
  - minor, specialization, concentration, track, certificate program

**DEPARTMENT**

(Signature indicates approval)

Dept. Curriculum Chair / Date

*Abera Abay* 5/15/01

Dept. Chairperson / Date

*Ronald J. Gorden* 5/15/01

**ACADEMIC DEAN**

Approved  Not Approved  Comments:

Dean's Signature/Date *[Signature]* 10/20/01

**COLLEGE CURRICULUM COMMITTEE**

Date of open hearing (if necessary) 12-3-01 Approved  Not Approved

Comments:

Signature of College Chair/Date: [Signature] 1-17-02

**UNIVERSITY CURRICULUM COMMITTEE**

Date Received/Processed \_\_\_\_\_

Comments: please see attached letters from sponsor + me

Curriculum Chair Signature [Signature] Date Announced At Senate 1/29/02

**EXECUTIVE VICE PRESIDENT/PROVOST**

Approved  Not Approved  If no, reasons are as follows:

Student Credit Hours \_\_\_\_\_ Faculty Load Hours \_\_\_\_\_ Equalized Credit Hours \_\_\_\_\_

Official Copy & Approval Sheet Filed (Date): \_\_\_\_\_ Executive VP/Provost Signature/Date [Signature]  
2/22/02

**REGISTRAR**

Date Approved Course Description Received \_\_\_\_\_ Hegis Taxonomy & Course Number Assigned 178-411

Registrar Signature/Date [Signature] 2/27/02

**NOTIFICATION FORWARD**

Senate Curriculum Committee Chairperson  Academic Dean(s)  
 Department Chairpersons  Registrar

[Signature]  
3/6/02  
\_\_\_\_\_  
Sponsor(s)

Rowan University  
Department of Mathematics

Course Proposal

Deterministic Models in Operations Research

**I. Details**

- a) **Course Title:** Deterministic Models in Operations Research
- b) **Sponsor:** Dr. Chris Lacke, Department of Mathematics
- c) **Credit Hours:** 3 credit hours
- d) **Course Level:** Senior
- e) **Curricular Effect:** Elective course for students majoring in Mathematics, Engineering and Computer Science.
- f) **Prerequisites:** 1701.230 Calculus III and 1701.210 Linear Algebra  
or  
1701.235 Math for Engineering Analysis I  
or  
Permission of the instructor.
- g) **Suggested Time, Implementation:** This course will be offered once every other fall.
- h) **Resources:** Faculty, equipment and library resources are adequate.

**II. Rationale**

The development of mathematical applications in business, government and the military during the 20<sup>th</sup> century has been phenomenal. It is no longer sufficient to find a solution to a problem, but rather to develop a methodology to provide the optimal solution to a problem. In its early days, operations research was used by the British military to find the best way to move all of its forces and equipment across the English Channel. Modern applications include portfolio theory, environmental and communication systems development, hospital staffing, and production planning. Operations researchers use their strong mathematical background to find a best solution to a problem, given a specific set of limitations, or constraints. A vast mathematical background is required, as operations researchers are required to build mathematical models that can involve virtually any type of mathematical function. Moreover, operations researchers need to be able to convert everyday phenomena to mathematical expressions. The extensive growth of the Institute for Operations Research and the Management Sciences (INFORMS) during the 1980's and 1990's has been, in large part, to the demand for qualified students in this field.

While extensive study in Operations Research is usually done on the graduate level, many undergraduate institutions now offer introductory courses in Operations Research. The growth in this area is due to the increased demand for undergraduates with some training in Operations Research, as well as providing exposure to a subject that used to be dominated by engineers doing graduate study. Students taking the Operations Research and Probability and Statistics sequences

will greatly enhance their career options, as well as the number of fields that they can pursue in graduate school.

This is the first member of a two-course sequence designed to provide a strong introduction in Operations Research, regardless of the student's industrial or academic future pursuits. A graduate version of this course, 1703.5XX, Operations Research I, will be offered concurrently. Details of the extra expectations placed on the graduate students are described in the accompanying proposal.

### **III. Essence of the Course**

#### **a) Objectives in Relation to Student Outcomes**

Students in this course will become familiar with the process of Operations Research: learning how to create and validate a mathematical model, as well as the processes and optimization/sub-optimization. They will learn how to determine solutions using linear and dynamic programming. They will also learn how to make an optimal set of assignments, based on a set of costs or demands. They will learn how to determine optimal shipping and inventory policies. All of the types of modeling covered in this course will be deterministic, that is, lacking any uncertainty. Reliance on the tools in the Calculus and Linear Algebra will be substantial, but we will also examine the reasons why these tools provide us with an optimal solution in each scenario. In addition, we will examine how multiple modeling procedures can be used to arrive at the same result, as well as the benefits and pitfalls of the different techniques. Furthermore, students will learn a procedure called *sensitivity analysis*, which is used to determine what types of changes are necessary for our optimal solution to become sub-optimal. Use of some of the leading software in the field, which is included in the text, will be required.

#### **b) Topical Outline**

1. History of Operations Research
2. Operations Research Modeling Approach
  - Model Formation
  - Solution Derivation
  - Model Validation and Implementation
3. Linear Programming
  - Graphical Methodology
  - Simplex Method
  - Shadow Prices
  - Slack and Surplus Variables
  - Post-Optimality Analysis
  - Selected Interior-Point Algorithms
  - Duality Theory
  - Dual-Primal Simplex Algorithm
  - Sensitivity Analysis
  - Computer Implementation

4. Transportation and Assignment Problems

Using Dummy Variables  
Big-M Method  
Linear Programming Representation  
Computer Implementation

5. Integer Programming

Binary Integer Programming Problems  
Mixed Integer Programming Problems  
Branch-and-Bound Algorithm  
Computer Implementation

6. Deterministic Dynamic Programming

Characteristics of Dynamic Programming Problems  
Development of Algorithms to Solve DP Problems

7. Deterministic Inventory Theory

Continuous-Review Models  
Periodic-Review Models  
Modeling Corporate "Goodwill"

c) **Evaluation and Grading**

Students will be evaluated by traditional methods of homework, which will include analytic and computer-based problems, and written exams. Students will also prepare solutions to class projects and be required to make a brief presentation at the end of the semester. Additional methods, such as journal reviews, may also be used.

d) **Course Evaluation**

The course will be evaluated through customary student evaluations as well as regular departmental review.

**IV) Consultation**

The content and nature of this course was discussed with:

1. Dr. T. R. Chandrupatla , Department of Mechanical Engineering
2. Dr. Ralph Dusseau, Department of Civil and Environmental Engineering
3. Dr. Jennifer S. Kay, Department of Computer Science
4. Dr. JooH Lee, Department of Management and M.I.S.

V) This proposal has been reviewed by the Department of Mathematics' Curriculum Committee.

**VI) Catalogue Description**

1703.411      Deterministic Models in Operations Research

(Prerequisites: Either 1701.230 Calculus III and 1701.210 Linear Algebra **or** 1701.235 Math for Engineering Analysis I **or** permission of the instructor.)

V  
This course is an introduction to mathematical modeling, analysis, and solution procedures applicable to decision-making problems in deterministic environment. Methodologies covered include the simplex and interior point methods of solving linear programming models, inventory theory, assignment and transportation problems, dynamic programming and sensitivity analysis. Solutions will be obtained using theoretical methods and software packages.



*Mechanical Engineering Department*

October 12, 2000

TO: Dr. Chris Lacke, Assistant Professor of Mathematics

FROM: Dr. T.R. Chandrupatla, Professor and Chair, Mechanical Engineering

*T.R. Chandrupatla*

Re: Consultation for course proposals in Operations Research (OR)

I have reviewed the course proposals for the following courses that you put forward.

1703.4xx	Deterministic Models in OR
1703.4xx	Stochastic Models in OR
1703.5xx	OR I
1703.5xx	OR II

The two course sequence in OR is a good proposition. Having the 5xx course and its companion 4xx undergraduate elective provides better structure to the course. The work must be planned to differentiate between the graduate and undergraduate students. Parts of Deterministic Models in OR and OR I overlap with our course on Optimization but this overlap is acceptable to me. In our course, we approach with an engineering design approach, while the proposed course dwells more on the mathematical aspects.

I expect that our Mechanical Engineering students will have an option of taking either of the two 4xx courses as Science and Math Elective. The graduate courses may be acceptable for our MS in Engineering program. This needs further discussion before a final decision is made.

In the Deterministic Models in OR and OR I, the Big-M Method is given as a part of Transportation and Assignment Problems (Topic 4). Big-M Method may have to be placed in Topic 3 on Linear Programming, where it is used with certain type of constraints.

I strongly support the offering of these courses.

**From:** "Ralph A. Dusseau" <Dusseau@rowan.edu>  
**To:** <lacke@rowan.edu>  
**Date:** 10/20/00 11:10AM  
**Subject:** Consultation

Dear Chris:

Attached is our consultation for your operations research courses.  
If you have any questions, please feel free to contact me.

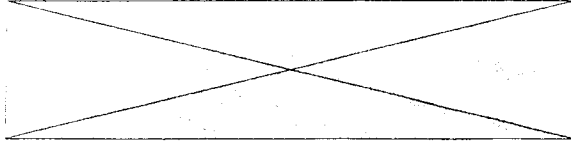
Thank you very much for your efforts in creating these new courses.

Ralph Alan Dusseau, Ph.D., P.E.  
DRBA Professor and Chair  
Civil and Environmental Engineering  
College of Engineering  
Rowan Hall  
Rowan University  
201 Mullica Hill Road  
Glassboro, New Jersey 08028-1701  
Telephone: (856) 256-5322  
Fax: (856) 256-5242  
E-mail: dusseau@rowan.edu



*Department of Civil and Environmental Engineering*

To: Chris Lacke, Assistant Professor of Mathematics.



From: Ralph Alan Dusseau, Professor and Chair

Date: October 20, 2000

Re: Consultation

The Civil and Environmental Engineering faculty have reviewed your proposals for the following four courses:

1703.4xx	Deterministic Models in Operations Research
1703.4xx	Stochastic Models in Operations Research
1703.5xx	Operations Research I
1703.5xx	Operations Research II

We strongly support these course proposals. We endorse the two undergraduate courses in Operations Research as possible Technical Elective courses for our undergraduate Civil and Environmental students. In addition, we also endorse the Operations I and II courses as Math Elective courses for both the Civil Engineering Specialization and the Environmental Engineering Specialization within the Master of Science in Engineering Program.

If you have any questions concerning this consultation, please feel free to contact me.



*Department of Computer Science*

**MEMORANDUM**

To: Dr. Chris Lacke, Mathematics

From: Dr. Jennifer Kay, Chair Computer Science Curriculum Committee

Date: April 2nd, 2001

Subject: Course proposal for Deterministic Models in Operations Research

The Computer Science Department has reviewed the course proposal for Deterministic Models in Operations Research. The CS Department supports this proposal.

**From:** Jooh Lee  
**To:** Lacke, Christopher J.  
**Date:** 4/2/01 3:15PM  
**Subject:** Re: course proposals

Dear Professor Chris Lacke

In reference to two new course proposals (Stochastic Models in Operations Research and Deterministic Models in Operations Research), please accept my comments on it. Overall, both courses would be very interesting and informative to the students in Math and Engineering fields. But I would like to provide the following comments with respect to OR subject.

First, there may be some key subject to be covered in OR field : (1) Network Model and Project Scheduling (PERT/CPM) and (3) Decision Making in both Deterministic and in Stochastic approach in addition to Decision Trees. Second, if it is not targeted for the graduate level, it may be more feasible to offer one solid OR course (rather than two split courses (which is designed to focus on the fundamental concepts and techniques of OR. For example, inventory must be covered in a continuous format regardless of two different possible perspectives particularly because it is one unique subject. Fourth, some key contents should be added to topical outline: for example, Problem formulation in L.P. and Poisson Distribution in Queuing Theory. Fifth, more computer application to each modules should be emphasized. Sixth, the students may be expected to have more strong statistical knowledge to handle advanced OR tools. Finally, I would like to suggest a comprehensive but general approach to OR subject to attract more various group of students including business majors.

Thanks for your sincere consideration in tuning up this course proposal.

Dr. Jooh Lee  
Professor and Chairman  
Department of Management and MIS  
College of Business, Rowan University  
Glassboro, NJ 08028

Phone : 856-256-4035  
Fax : 856-256-4439  
Hand : 856-371-2020 (Emergency only)  
Email : LEE@ROWAN.EDU

>>> Christopher J. Lacke 03/14/01 02:44PM >>>

Dear Jooh:

Here are the course proposals for Operations Research. Thanks for taking a look at them.

Chris

Christopher Jay Lacke  
Mathematics Department  
Rowan University  
Glassboro, NJ 08028  
(856) 256-4500 x3897  
(856) 256-4816 (fax)  
<http://www.rowan.edu/mars/depts/math/lacke/lacke1.html>

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"I hit the ground so hard, even my cape hurts" - Super Grover  
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*Mathematics Department*

February 7, 2002

To: Dr. Laretta Reeves, Chair – University Curriculum Committee

From: Dr. Christopher Lacke, Department of Mathematics

Re: Operations Research course proposals

Included with my course proposals in Operations Research was a letter from Dr. Jooh Lee in which he expressed some concerns regarding the course proposals. Before I make my comments regarding some of his more specific statements, I should note that the College of Business offers 0507.430 Principles of Management Science. I submitted a consultation request to Dr. Lee because Operations Research and Management Science are related subjects, and I wanted to show him that I was not trying to create a set of courses to replace his course, as he often teaches Management Science.

The greatest difference between the two fields is based on the coverage of mathematics in the courses. Management Science, especially on the undergraduate level, concentrates on setting up problems and using computer software to solve the problems. Much of the mathematics is left out. In Operations Research, we study the modeling aspect, but we also study the mathematical algorithms used to solve the problems, how they work and why they work. We can also take advantage of a number of the software tools to solve larger problems. Because of this difference, students need to have the mathematical background to study the algorithms at the level that is expected in Operations Research.

With regard to Dr. Lee's comments, I have the following responses:

1. The comment regarding PERT/CPM and Decision Making is unclear. The topics are listed in the syllabi.
2. I am familiar with institutions that attempt to teach both deterministic and stochastic Operations Research in one semester. In order to cover the topics, all of the mathematical rigor must be removed, which results in a management science course.
3. Problem formulation is a general topic in Operations Research and is included under item 2 in the topical outline. It is absolutely necessary in every component of the course, but rather than list it ten times, I included it early in the list, with the knowledge that it has to be covered in every situation.
4. The Poisson distribution is covered in great detail in 1702.360 Introduction to Probability and Statistics I, which is a prerequisite for the courses that involve queuing theory.
5. We are looking at computer applications, but this is a math course. To substantially increase the time dedicated to computer applications would again reduce the mathematical rigor, again making this a management science course.



*Mathematics Department*

6. Business majors who have the requisite mathematical background are more than welcome to take the Operations Research courses. We have had some business majors minor in mathematics. The core requirement for the minor contains the prerequisites for the deterministic OR course, where as Introduction to Probability and Statistics I, which is the third requirement for the stochastic OR course, would count as an elective for the minor. The OR courses would fulfill the remainder of the minor requirements.

If you have any further questions or concerns, please feel free to contact me. Thanks for your help in this matter.

cc: Czocho, R.