LSC Use Only No:	LSC Action-Date:	UWUCC USE Only No.	UWUCC Action-Date:	Senate Action Date:
		03-43a	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

Current Course prefix, number and full title	*Proposed* course prefix, number and full title, if changing
MATH 445 Programming Models in Operations Research	MATH 445 Deterministic Models in Operations Research

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		3/18/04
Director of Liberal Studies *		
Director of Honors College *		
Provost *		
Additional signatures as appropriate:		
(include title)		
UWUCC Co-Chairs	Gail Sechrist	4-6-04

* where applicable

I. Catalog Description

MATH 445 Deterministic Models in Operations Research — 3 class hours, 0 lab hours, 3 credits (3c-0l-3cr)

Prerequisites: MATH 122 or 124; MATH 171

An introductory course on using the basic tools of solving deterministic models in operations research. Topics include optimization techniques and applications such as linear programming, nonlinear and dynamic programming, transportation models, and network models. In addition, sensitivity analysis, duality, simplex methods, and integer programming are discussed. Students will use technology to solve problems and interpret the results.

II. Course Objectives

Students will be able to:

1. Formulate a mathematical model of a problem, solve the mathematical model, verify the model, and present the results of the analysis.
2. Use appropriate computer software to solve the problems of operations research.
3. Solve linear programming problems using various techniques.
4. Find and solve the dual of a programming problem.
5. Solve transportation problems.
6. Apply the techniques of PERT/CPM.
7. Solve integer programming problems using various techniques.
8. Solve dynamic programming problems using various techniques.

III. Course Outline

A. Introduction to Operations Research — 2 hours
   1. Methodology
   2. Examples

B. Linear Programming — 8 hours
   1. Definition of terms
      a. objective function
      b. constraints
      c. feasible region
   2. Graphical Solutions
   3. Simplex Algorithm
   4. Karmarkar's Method

C. Sensitivity Analysis and Duality: — 6 hours
   1. Sensitivity Analysis
   2. The Dual of a Linear Programming Problem
   3. Shadow Prices and Complementary Slackness
   4. Dual Simplex Method

D. Transportation Models — 3 hours
   1. Formulation
   2. Transportation Simplex Method
   3. Sensitivity Analysis

E. Network Models — 3 hours
   1. Shortest Path Problems
   2. Maximum Flow Problems
   3. CPM and PERT
   4. Minimum Spanning Tree

F. Integer Programming — 6 hours
   1. Formulation
   2. Branch and Bound Method
   3. Knapsack Problems

G. Deterministic Dynamic Programming — 3 hours
   1. Network Problems
   2. Inventory Problems

H. Advanced Optimization — 2 hours
   1. Revised Simplex Algorithm
   2. Introduction to nonlinear programming

This syllabus leaves 3 hours for tests and 6 hours for presentation of student projects.

Final Exam—During Final Exam Week.

IV. Evaluation Methods

Grades will be based on homework assignments, projects, tests, and a comprehensive final examination.

The final grade will be determined as follows:

Homework assignments	20%
Tests	40%
Oral and Written Project	20%
Final Exam	20%

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 the University policy.

VI. Required Textbook(s), Supplemental Books and Readings

Winston, Wayne L. (2004) *Operations Research - Applications and Algorithms*, 4th ed. Belmont, CA: Duxbury Press.

VII. Special Resources or Requirements

None.

VIII. Bibliography

Bazaraa, Mokhtar S., John J. Jarvis, and Hanif D. Shera (1990). *Linear Programming and Network Flows*. New York: John Wiley and Sons.

Bryson, Arthur E. (1999). *Dynamic Optimization*. Upper Saddle River, NJ: Pearson Education.

Dantzig, George B. (1998). *Linear Programming and Extensions*. Princeton, NJ: Princeton University Press.

Hillier Frederick. S. and Gerald J. Lieberman. (2002). *Introduction to Operations Research.* New York: McGraw Hill.

Luenberger, David G. (1984). *Linear and Nonlinear Programming*. Reading, MA: Addison-Wesley Publishing

Murty, Katta. (1983). *Linear and Combinatorial Programming*. New York: John Wiley and Sons.

Taha, Hamdy (2002). *Operations Research: An Introduction*. Upper Saddle River, NJ: Prentice Hall.

Winston, Wayne L. and Munirpallam Venkataramanan. (2003). *Introduction to Mathematical Programming - Applications and Algorithms* . Belmont, CA: Duxbury Press.

Wright, Margaret and Philip E. Gill. (1982). *Practical Optimization*. Burlington MA: Academic Press.

2. Summary of Proposed Revisions

We are changing the prerequisite, title, and course description. The old prerequisite is "a two semester sequence of calculus." We are changing this to MATH 171 AND MATH 122 or MATH 124.

3. Justification for the Revision

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 171 is an introductory course in linear algebra (matrices, etc.) Matrix techniques are essential in solving linear programming problems.

We are changing the title and course description to emphasize the mathematics behind the techniques of the course. This course has always emphasized the mathematics, we are just making it explicit.

4. Old Syllabus of Record
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Mathematics Department
Indiana University of Pennsylvania
Indiana, PA 15705

Course Number: MA 445/545

Course Title: Programming Models in Operations Research

Credits: 3 semester hours

Prerequisites: Two semester sequence of Calculus

Textbook: Operations Research Applications and Algorithms
by Winston
PWS-Kent

Revised: 9/94

Catalog Description:

Development of deterministic mathematical models for managerial and social sciences with relative computational techniques.

Course Outline/Time Schedule:

I. Brief introduction to building and using mathematical models (1 week)

II. Linear Programming (4 weeks)
- A. Formulation of a Linear Program
- B. Graphical Solution
- C. Solution using the Simplex Algorithm
- D. Sensitivity Analysis
- E. Duality
- F. Dual Simplex Algorithm
- G. Solution Using Various Software Packages

III. Applications of Linear Programming (2 weeks)
- A. Transportation Problem Model
  1. Formulation of Transportation Algorithm
  2. Assignment Model
  3. Transshipment Model
- B. Network Models
  1. Formulation of Network Algorithms
  2. Shortest–Route Model

3. Maximal-Flow Model
4. Traveling Salesman Model
5. Critical Path Method
6. Knapsack Model

IV. Advanced Topics in Linear Programming (2 weeks)
- A. Revised Simplex Algorithm
- B. Integer Programming
  1. Cutting-Plane Algorithms
  2. Branch-and-Bound 'Method
  3. Zero-One Implicit Enumeration

V. Dynamic (Multistage) Programming (1 week)
- A. Formulation of a Dynamic Program
- B. Solution of Linear Programs by Dynamic Programming

VI. Introduction to Nonlinear Programming (1 week)

VII. Student Projects (2 weeks)
- A. Student presentations of projects completed during the semester