School of Mathematical Sciences

☑ New ☐ Revised COURSE: COS-MATH-311 Linear Optimization

1.0 Course designations and approvals:

<table>
<thead>
<tr>
<th>Required Course Approvals:</th>
<th>Approval Request Date</th>
<th>Approval Grant Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Unit Curriculum Committee</td>
<td>4-08-10</td>
<td>4-15-10</td>
</tr>
<tr>
<td>College Curriculum Committee</td>
<td>11-01-10</td>
<td>9-20-11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optional Course Designations:</th>
<th>Yes</th>
<th>No</th>
<th>Approval Request Date</th>
<th>Approval Grant Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>✔</td>
<td></td>
<td></td>
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<tr>
<td>Writing Intensive</td>
<td></td>
<td>✔</td>
<td></td>
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<tr>
<td>Honors</td>
<td></td>
<td>✔</td>
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2.0 Course information:

Course Title: Linear Optimization
Credit Hours: 3
Prerequisite(s): COS-MATH-241 or permission of instructor
Co-requisite(s): None
Course proposed by: School of Mathematical Sciences
Effective date: Fall 2013

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Maximum Students/section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>3</td>
</tr>
<tr>
<td>Lab</td>
<td></td>
</tr>
<tr>
<td>Workshop</td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
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</tbody>
</table>

2.1 Course conversion designation: (Please check which applies to this course)

☑ Semester Equivalent (SE) to: 1016-465
☐ Semester Replacement (SR) to:
☐ New

2.2 Semester(s) offered:

☐ Fall ☑ Spring ☐ Summer
☐ Offered every other year only ☐ Other
2.3 Student requirements:
Students required to take this course: (by program and year, as appropriate)
None
Students who might elect to take the course:
Students majoring in Applied Statistics, Applied Mathematics, Computational Mathematics, students pursuing a minor in Mathematics, and students in Industrial Engineering, Computer Science or Business

3.0 Goals of the course: (including rationale for the course, when appropriate)

3.1 To illustrate the variety of optimization problems which can be formulated as linear programming problems.
3.2 To introduce general linear programming problems.
3.3 To teach the simplex method to solve linear programming problems.
3.4 To teach linear programming models in different areas such as transportation, resource allocation, facilities planning, and assignment.

4.0 Course description: (as it will appear in the RIT Catalog, including pre- and co-requisites, semesters offered)

COS-MATH-311 Linear Optimization
This course presents the general linear programming problem. Topics include a review of pertinent matrix theory, convex sets and systems of linear inequalities, the simplex method of solution, artificial bases, duality, parametric programming, and applications. (COS-MATH-241 or permission of instructor) Class 3, Credit 3 (S)

5.0 Possible resources: (texts, references, computer packages, etc.)


6.0 Topics: (outline) Topics with an asterisk(*) are at the instructor’s discretion, as time permits

6.1 Review of Matrix Algebra
6.2 Formulation of Linear Programming Problems
   6.2.1 Examples of linear programming problems
   6.2.2 Graphical solution of linear programming problems
   6.2.3 Extreme points
   6.2.4 Basic feasible solutions
6.3 Simplex Method and Variations
   6.3.1 Unbounded solutions
6.3.2 Degenerate solution
6.3.3 Cycling in linear programming problems
6.3.4 Artificial variables: Big-M and two-phase methods

6.4 Duality
6.4.1 Writing the dual of an linear programming problem
6.4.2 Economic interpretation of the dual
6.4.3 Weak and strong duality theorems
6.4.4 Duality and sensitivity analysis
6.4.5 Shadow prices
6.4.6 Complementary slackness
6.4.7 Dual simplex method

6.5 Special Cases
6.5.1 Transportation problem
6.5.2 Assignment problem

6.6 Use of the LINDO software

7.0 Intended learning outcomes and associated assessment methods of those outcomes:

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Assessment Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Homework</td>
</tr>
<tr>
<td>7.1 Identify problems which can be formulated as a linear programming problem</td>
<td>✓</td>
</tr>
<tr>
<td>7.2 Use the simplex method to solve linear programming problems</td>
<td>✓</td>
</tr>
<tr>
<td>7.3 Explain the mathematics behind the simplex method</td>
<td>✓</td>
</tr>
</tbody>
</table>

8.0 Program goals supported by this course:

8.1 To develop an understanding of the mathematical framework that supports engineering, science, and mathematics.
8.2 To develop critical and analytical thinking.
8.3 To develop an appropriate level of mathematical literacy and competency.
8.4 To provide an acquaintance with mathematical notation used to express physical and natural laws.
9.0 General education learning outcomes and/or goals supported by this course:

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<tr>
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<td>Homework</td>
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### Communication
9.1
- Express themselves effectively in common college-level written forms using standard American English
- Revise and improve written and visual content
- Express themselves effectively in presentations, either in spoken standard American English or sign language (American Sign Language or English-based Signing)
- Comprehend information accessed through reading and discussion

### Intellectual Inquiry
9.2
- Review, assess, and draw conclusions about hypotheses and theories
- Analyze arguments, in relation to their premises, assumptions, contexts, and conclusions
- Construct logical and reasonable arguments that include anticipation of counterarguments
- Use relevant evidence gathered through accepted scholarly methods and properly acknowledge sources of information

### Ethical, Social and Global Awareness
9.3
- Analyze similarities and differences in human experiences and consequent perspectives
- Examine connections among the world’s populations
- Identify contemporary ethical questions and relevant stakeholder positions

### Scientific, Mathematical and Technological Literacy
9.4
- Explain basic principles and concepts of one of the natural sciences
- Apply methods of scientific inquiry and problem solving to contemporary issues
- Comprehend and evaluate mathematical and statistical information
- Perform college-level mathematical operations on quantitative data
- Describe the potential and the limitations of technology
- Use appropriate technology to achieve desired outcomes

X

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<td>Homework</td>
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<tr>
<td>9.5 Creativity, Innovation and Artistic Literacy</td>
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<tr>
<td>Demonstrate creative/innovative approaches to course-based assignments or projects</td>
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<tr>
<td>Interpret and evaluate artistic expression considering the cultural context in which it was created</td>
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**10.0 Other relevant information:** (such as special classroom, studio, or lab needs, special scheduling, media requirements, etc.)

10.1 Simulation software: MATLAB, LINDO

10.2 Smart classroom