School of Mathematical Sciences

✓ New  □ Revised  COURSE: COS-MATH-603 Optimization Theory

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>10-20-10</td>
<td>10-27-10</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>
<td></td>
</tr>
<tr>
<td>Writing Intensive</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
<td>Honors</td>
<td></td>
<td>✓</td>
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</table>

2.0 Course information:

Course Title:  Optimization Theory
Credit Hours:  3
Prerequisite(s):  COS-MATH-601 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></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: 1016-766
□ 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 the course:
None

Students who might elect to take the course:
Graduate students and advanced undergraduate students in mathematics, physics, imaging science, business, or engineering

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

3.1 To demonstrate the methods of optimization of linear and nonlinear functions of several variables with or without constraints.
3.2 To provide experience with the general optimization problem.
3.3 To analyze various optimization algorithms for applications.
3.4 To introduce the use of software in solving optimization problems and to implement these algorithms.

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

COS-MATH-603 Optimization Theory
This course provides a study of the theory of optimization of linear and nonlinear functions of several variable with or without constraints. The theory is applied to solve problems in business, management, engineering, and the sciences. Algorithms for practical applications will be analyzed and implemented. Students taking this course will be expected to complete applied projects and/or case studies. (COS-MATH-241 or permission of instructor) **Class 3, Credit 3 (S, alternate years)**

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 Integer Programming
   6.1.1 Branch and bound methods
   6.1.2 Implicit enumeration
   6.1.3 Cutting plane methods
   6.1.4 Applications
6.2 Nonlinear Optimization
   6.2.1 Unconstrained optimization
   6.2.2 Search algorithms
   6.2.3 Constrained optimization
   6.2.4 Lagrange multipliers
   6.2.5 Kuhn-Tucker theory
   6.2.6 Gradient methods

6.3 Dynamic Programming
   6.3.1 Deterministic dynamic programming
   6.3.2 Probabilistic dynamic programming

6.4 Network Flows

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>7.1 Apply integer programming and implicit enumeration</td>
<td>✓</td>
</tr>
<tr>
<td>7.2 Develop unconstrained and constrained optimization</td>
<td>✓</td>
</tr>
<tr>
<td>7.3 Compute Lagrange multipliers and gradients</td>
<td>✓</td>
</tr>
<tr>
<td>7.4 Apply deterministic and probabilistic dynamic programming</td>
<td>✓</td>
</tr>
<tr>
<td>7.5 Apply network flows</td>
<td>✓</td>
</tr>
<tr>
<td>7.6 Use a programming language and software to implement the algorithms</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: Not applicable

10.0 Other relevant information: (such as special classroom, studio, or lab needs, special scheduling, media requirements, etc.)
Smart classroom