New  Revised  COURSE: COS-MATH-641 Logic, Set Theory, and Computability

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>
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<tbody>
<tr>
<td>General Education</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: Logic, Set Theory, and Computability
Credit Hours: 3
Prerequisite(s): 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>
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</table>

2.1 Course Conversion Designation: (Please check which applies to this course)

✓ Semester Equivalent (SE) to: 1016-764
☐ 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, or engineering

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

3.1 To study set theory and its relationship to modern logic and computability.

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

**COS-MATH-641 Logic, Set Theory, and Computability**
This course studies Peano’s axioms for the natural numbers, induction principles, and recursive definitions. The topics in set theory include axiomatic set theory and the Cantor-Bernstein theorem. The topics in logic are propositional logic and First-order logic. The section on computability covers formulation of the family of the computable functions and a discussion of the halting problem. (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 Natural Numbers
   6.1.1 Peano’s axioms
   6.1.2 Induction principles
   6.1.3 Recursive definitions

6.2 Set Theory
   6.2.1 Zermelo-Frankel axioms
   6.2.2 Axiom of choice and equivalents
   6.2.3 Countable and uncountable sets
   6.2.4 Cantor-Bernstein theorem
   6.2.5 Diagonal arguments

6.3 Logic
   6.3.1 Propositional logic
   6.3.2 First order logic

6.4 Computability
   6.4.1 Discrete mathematics formulation of the set of computable functions
   6.4.2 Diagonal arguments and the Halting Problem
7.0 Intended learning outcomes and associated assessment methods of those outcomes:

<table>
<thead>
<tr>
<th>Learning Outcomes</th>
<th>Assessment Methods</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Homework</td>
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<tr>
<td>Use recursive definitions</td>
<td>✓</td>
</tr>
<tr>
<td>Analyze the Zermelo-Fraenkel axioms of set theory</td>
<td>✓</td>
</tr>
<tr>
<td>Formulate equivalent versions of the axiom of choice</td>
<td>✓</td>
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</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.)
None