School of Mathematical Sciences

☑ New ☐ Revised COURSE: COS-MATH-761 Mathematical Biology

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>
</tr>
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<tbody>
<tr>
<td>General Education</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Writing Intensive</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Honors</td>
<td>✓</td>
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</tbody>
</table>

2.0 Course information:

Course Title: Mathematical Biology
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>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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</tbody>
</table>

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

☑ Semester Equivalent (SE) to: 1016-862
☐ 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, biology, or engineering

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

3.1 Introduce areas of the biological sciences in which mathematics has a significant contribution to make.

3.2 Present different modeling approaches to understand and capture the essence of a wide variety of biological phenomena.

3.3 Introduce some of the analytical and computational methods used to study biological phenomena.

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

**COS-MATH-761 Mathematical Biology**

This course introduces areas of biological sciences in which mathematics can be used to capture essential interactions within a system. Different modeling approaches to various biological and physiological phenomena are developed (e.g., population and cell growth, spread of disease, epidemiology, biological fluid dynamics, nutrient transport, biochemical reactions, tumor growth, genetics). The emphasis is on the use of mathematics to unify related concepts. (COS-MATH-601 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

Depending on the interest of the instructor, 3 or 4 topics from the following list may be chosen. Additional topics may be included.

6.1 Diffusion Models in Biology

6.1.1 Cell organization, structures and function

6.1.2 Chemostat

6.1.3 Reaction kinetics
6.1.4 Transport of nutrients
6.1.5 Tumor growth

6.2 Limit Cycles and Dynamical Systems in Biology
   6.2.1 Flow in neurons
   6.2.2 Hodgkin-Huxley equation
   6.2.3 Fitzhugh-Nagumo equations
   6.2.4 Oscillations

6.3 Genetic Modeling
   6.3.1 Mendelian models
   6.3.2 Gene frequencies

6.4 Population Dynamics
   6.4.1 Malthusian, logistic and variations
   6.4.2 Competition models
   6.4.3 Structured models

6.5 Epidemic Modeling
   6.5.1 Susceptible, infected and recovered (SIR) models
   6.5.2 Susceptible, infected and susceptible (SIS) models
   6.5.3 Susceptible, exposed, infected and recovered (SEIR) models
   6.5.4 Vector transmitted disease models
   6.5.5 Structured population transmission models

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 Apply diffusion models in different areas of biology</td>
<td>✓</td>
</tr>
<tr>
<td>7.2 Identify limit cycles and other dynamical systems constructs in biological models</td>
<td>✓</td>
</tr>
<tr>
<td>7.3 Use wave propagation models</td>
<td>✓</td>
</tr>
<tr>
<td>7.4 Investigate population dynamic models</td>
<td>✓</td>
</tr>
<tr>
<td>7.5 Develop various models of epidemics and make predictions</td>
<td>✓</td>
</tr>
<tr>
<td>7.6 Apply probability models in genetics</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