School of Mathematical Sciences

☑ New ☐ Revised COURSE: COS-MATH-741 Partial Differential Equations I

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>2-4-11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optional Course Designations: 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>
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</table>

2.0 Course information:

Course Title: Partial Differential Equations I
Credit Hours: 3
Prerequisite(s): COS-MATH-231 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:
☑ Semester Replacement (SR) to: parts of 1016-807, 1016-808
☐ 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:
Applied and Computational Mathematics graduate students in the Dynamical Systems concentration

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 use the mathematical tools of applied mathematics
3.2 To model problems that arise in physics and engineering using partial differential equations with boundary conditions

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

COS-MATH-741 Partial Differential Equations I
This course uses methods of applied mathematics in the solution of problems in physics and engineering. Models such as heat flow and vibrating strings will be formulated from physical principles. Characteristics methods, maximum principles, Greens’s functions, D’Alembert formulas, weak solutions and distributions will be studied. (COS-MATH-231 or permission of instructor) Class 3, Credit 3 (F)

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

5.1 Yehuda Pinchover and Jacob Rubinstein, An Introduction to PDEs, Cambridge, Cambridge, UK.
5.3 Craig Evans, Partial Differential Equations, AMS, Providence, RI.

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

6.1 First Order Equations - Method of Characteristics
   6.1.1 Linear equations
   6.1.2 Quasilinear equations
   6.1.3 Conservation laws and shock waves, Rankine-Hugoniot condition
   6.1.4 Weak solutions
   6.1.5 Nonlinear equations

6.2 Second Order Linear Equations in Two Variables
   6.2.1 Classification
   6.2.2 Canonical form for hyperbolic equations
   6.2.3 Canonical form for parabolic equations
   6.2.4 Canonical form for elliptic equations

6.3 One Dimensional Wave Equations
6.3.1 Cauchy problem and D’Alembert formula
6.3.2 Domain of dependence and region of influence
6.3.3 Cauchy problem for the nonhomogeneous equation
6.3.4 Separation of variables for the wave equation, energy methods and uniqueness
6.3.5 Separation of variables for the nonhomogeneous wave equation

6.4 Sturm-Liouville problems

6.5 Heat and Laplace Equations

6.5.1 Separation of variables for the heat equation
6.5.2 Maximum principle and uniqueness for the heat equation
6.5.3 Separation of variables for the Laplace equation
6.5.4 Maximum principle for the Laplace equation and applications
6.5.5 Poisson formula

6.6 Green’s Functions

6.6.1 Green’s identities
6.6.2 Green’s function for Dirichlet problem in plane
6.6.3 Neumann’s function in the plane
6.6.4 Heat kernel
6.6.5 Distributions

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 Calculate characteristic curves</td>
<td>✓</td>
</tr>
<tr>
<td>7.2 Compute canonical forms</td>
<td>✓</td>
</tr>
<tr>
<td>7.3 Solve the wave equation by D’Alembert formula</td>
<td>✓</td>
</tr>
<tr>
<td>7.4 Solve the heat, Laplace and wave equations by separation of variables</td>
<td>✓</td>
</tr>
<tr>
<td>7.5 Treat uniqueness methods</td>
<td>✓</td>
</tr>
<tr>
<td>7.6 Compute Greens functions</td>
<td>✓</td>
</tr>
<tr>
<td>7.7 Treat distributions</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.)

None