Prefix, Number and Name of Course:
ACM 601 Mathematical Modeling and Applications II

Credit Hours: 1
In Class Instructional Hours: 1
Labs: 0
Field Work: 0

Catalog Description:
Prerequisites: Instructor permission or admission to the program.
Mathematical modeling and applications of differential equations, simulation of
dynamical systems, and partial differential equations.

Reasons for Addition:
This 5-week course focuses on the practical aspects of the methods used in applied
mathematics. The Professional Applied and Computational Mathematics (PACM)
Master’s Program was developed to be flexible and adopt curriculum changes based on
the needs of graduate students as well as the industry/business involved with the program.
Topics are selected and examples are incorporated in order to satisfy those requirements.
Applications to areas include biology, fluid dynamics, chemistry, ecology, and finance.
Emphasis is on the team building and group management through problem solving
activities. The course will engage students with mathematical modeling concepts and
techniques that will provide hands on experience as well as prepare students for a variety
of possible future courses in the program and at the workplaces thereafter.

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Course Content References:</th>
<th>Assessment:</th>
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<tbody>
<tr>
<td>Students will</td>
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<tr>
<td>1. identify opportunities and utilize principles and methods of differential equations</td>
<td>I</td>
<td>Group work, individual homework</td>
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<td>and methods of differential equations to study phenomena and solve real life problems.</td>
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<td>assignments, examinations, and</td>
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<td></td>
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<td>projects.</td>
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<td>2. utilize technology in the mathematical modeling process.</td>
<td>II</td>
<td>Group work, individual homework</td>
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<tr>
<td></td>
<td></td>
<td>assignments, and projects.</td>
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<tr>
<td>3. identify opportunities and utilize fundamentals of partial differential equations</td>
<td>III</td>
<td>Group work, individual homework</td>
</tr>
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<td>(PDEs) and to study phenomena and solve real life problems.</td>
<td></td>
<td>assignments, examinations, and</td>
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<td></td>
<td></td>
<td>projects.</td>
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<td>4. work cooperatively and communicate (both orally and in writing) as team members when</td>
<td>I,II,III</td>
<td>Group work, projects, and</td>
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<td>solving problems, and/or presenting results.</td>
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<td>presentations.</td>
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Course Content:

1. Modeling with Continuous Dynamical Systems
   A. Modeling using linear and nonlinear differential equation systems
   B. Linearization and local dynamics
C. Eigenvalue methods (continuous)
D. Qualitative analysis (e.g. phase portraits)
E. Stability analysis
F. Case studies

II. Simulations of Dynamical Systems
A. Introduction to simulation techniques
B. The Euler method
C. The Runge-Kutta methods
D. Case studies

III. Modeling with Partial Differential Equations
A. Principles of modeling: physical laws and constitutive relations
B. Modeling using heat equation
C. Modeling using wave equation
D. Modeling using Laplace’s equation
E. Separation of variables

Resources:

Scholarship:


Periodicals:

College Mathematics Journal
Differential Equations and Applications
Differential Equations and Dynamical Systems
Dynamics of Partial Differential Equations
Journal of Partial Differential Equations
Mathematics Magazine
Notices of the American Mathematical Society
The American Mathematical Monthly

Electronic and/or Audiovisual Resources:

Undergraduate Applications in Mathematics Modules, COMAP
Scientific computing FAQ (http://mathcom.com/corpdir/techinfo.mdir/index.html)