UNIVERSITY OF MARY WASHINGTON -- NEW COURSE PROPOSAL

Electronically submit this completed form with attachments in one file to the Chair of the College Curriculum Committee.

COLLEGE (check one):  Arts and Sciences  v  Business  Education

Proposal Submitted By: Leo Lee  Date Prepared: 9/12/2016

Course Title: Applied Partial Differential Equations

Department/discipline and course number*: Math 421

Prerequisites: Math 223, 224, and 312

*This course number must be approved by the Office of the Registrar before the proposal is submitted.

Number of credits: 3  Will this course meet for at least 700 contact minutes for each credit hour proposed? If no, provide a credit hour justification.  YES  v  NO

Will this be a new, repeatable “special topics” course? (Do you want students to be able to take this new course more than once if the topic changes?)  NO  v  YES

Date of first offering of this new course: FALL SEMESTER, year  Fall 2017

Proposed frequency of offering of the course: Every 2 years

List the faculty who will likely teach the course: Lee, Sumner

Are ANY new resources required?  NO  v  YES  Document in attached impact statement

This new course will be (check all that apply):

Required in the major  v  Required in the minor  v  General Elective

Elective in the major  v  Elective in the minor  v  General Education**

**AFTER the new course is approved, a separate proposal must be sent to the General Education Committee.

Catalog Description (suggested length – less than 50 words):

This course introduces three main types of partial differential equations (PDEs): parabolic, elliptic, and hyperbolic as well as mathematical and computational tools for solving PDEs. It balances mathematical rigor, computational techniques, and real-world applications. Topics include heat equation, method of separation of variables, Laplace’s equation, Fourier series, wave equation, finite difference/element methods, and high-dimensional PDEs.

COURSE HISTORY:

Was this course taught previously as a topics or experimental course?  YES  v  NO

<table>
<thead>
<tr>
<th>Course Number and Title of Previous Course</th>
<th>Semester Offered</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 461L – Partial Differential Equations</td>
<td>Spring 2010</td>
<td>12</td>
</tr>
<tr>
<td>Math 461L – Partial Differential Equations</td>
<td>Spring 2012</td>
<td>14</td>
</tr>
<tr>
<td>Math 461L – Partial Differential Equations</td>
<td>Fall 2015</td>
<td>15</td>
</tr>
</tbody>
</table>

CHECK HERE if the proposed course is to be equated with the earlier topics or experimental offerings. If equated, students who took the earlier “topics” course will only be able to take the new course as a repeat (C- grade or lower).

NOTE: If the proposed course has not been previously offered as a topics or experimental course, explain in the attached rationale statement why the course should be adopted even though it has not been tried out.

REQUIRED ATTACHMENTS:

1. Rationale Statement – Why is this course needed? What purposes will it serve?
2. Credit Hour Justification (if required) – explain how this course will comply with the UMW Credit Hours Policy (D.5.1)
3. Impact Statement – Provide details about the Library, space, staffing, budget, and technology impacts created by adding this new course. Include supporting statements from the Library, IT Department, etc. Any change that impacts another Department must have a written statement (such as a copy of an email) from the Chair(s) agreeing to the change.
4. Sample Syllabus

New Course Proposal Cover Sheet (December 2015)
1. **Rationale Statement** – Why is this course needed? What purposes will it serve?

Most quantities change over time and/or with location. For instance, temperature changes over time and varies from one location to another. In mathematics, these changes could be expressed by equations containing one or more functions of more than one independent variable and its derivatives – this is due to the fact that the derivative measures the rate of change of a quantity (e.g., temperature) with respect to another quantity (e.g., time or location). We call such equations partial differential equations (PDEs). In fact, PDEs describe a large variety of physical phenomena; e.g., weather, water flow in a pipe, air flow around a wing, and motion of stars inside a galaxy (see Navier-Stokes-Fourier Equations by R.K. Zeytounian, Springer 2012).

This new course investigates real-life applications of mathematics in the following ways: first, we formulate three main types of PDEs showing why those PDEs can model some physical phenomena. Second, we introduce analytical tools to solve the model problems. Third, we derive numerical algorithms and use computer programs based on the algorithms to visualize the solutions of the model problems. Students who complete this class will acquire skills to make mathematical models, find analytical solutions of real-world problems, and do computer simulations with computational solutions. Such experiences would give our students better chances of getting hired in industries that rely on some mathematical/numerical methods to analyze models; e.g., the Naval Surface Warfare Center at Dahlgren (many of our math graduates find jobs there) always looks for people who have strong mathematical, computational, and modeling skills.

In this semester, the department will propose a change to the major that will require every student to take one course in which programming is central (this is our response to reviewers’ reports in our 10-year program review process and already approved by the Dean). Assuming approval, this new course will be one of the three math courses involving mathematical programming and give our majors flexibility to satisfy a computational/programming requirement (currently the department offers two such courses: Numerical Analysis I and II). Moreover, it will serve as an elective in the mathematics minor and/or the applied mathematics minor. Hence, the course supports not only our mathematics major and minor programs but also the career development of our students.

3. **Impact Statement** – Provide details about the Library, space, staffing, budget, and technology impacts created by adding this new course. Include supporting statements from the Library, IT Department, etc.

I do not expect any library, space, staffing, budget, or technology impacts created by adding this new course because:

a. this course has been already offered three times as a topics course about every 2 years without any impacts;
b. the department plans to use current faculty members to teach the course as part of their regular teaching load;
c. the department already has MATLAB (math programming language used in this course) installed on every computer in classrooms and math computer lab.
4. Sample Syllabus

Math 421 (Applied Partial Differential Equations) – Fall 2017
2 p.m. ~ 3:15 p.m. TR, Trinkle 119

Instructor: Dr. Jangwoon “Leo” Lee.
Office: 126 Trinkle.
Office Hours: MWF 1:50-3, TR 3:15-4, or by appointment.
E-mail: lle3@umw.edu.
Website: http://leolee.umwblogs.org

Prerequisite: Math 224 (Multivariable Calculus) and Math 312 (Differential Equations).

Course Goals and Objectives: In this course, students will:

- Understand partial differential equations (e.g., heat equation, Laplace’s equation, wave equation, and Sturm-Liouville equation) that model physical phenomena;
- Study Fourier series and the method of separation of variables to analyze some partial differential equations mathematically;
- Learn computational skills such as finite difference methods and finite element methods to solve mathematical model equations numerically.


References:


Homework: On my website, you can find a list of homework problems that need to be handed in. No late homework will be accepted.

New Course Proposal Cover Sheet (December 2015)
Exams (or Projects): You will have a midterm exam (or project) and a required final exam (or project). Final exam (or project) is scheduled on (or due by) Thursday, December 10th, 3:30 ~ 5 p.m.

Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>60 %</td>
</tr>
<tr>
<td>Midterm Exam (or project)</td>
<td>20 %</td>
</tr>
<tr>
<td>Final Exam (or project)</td>
<td>20 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>

Grading Scale: Your grade will be no worse than the standard 90-80-70-60. +/- grades will be given at the discretion of the instructor (here, the standard grading scale will be used as follows: 100 ~ 90: A, A-, 89 ~ 80: B+, B, B-, 79 ~ 70: C+, C, C-, 69 ~ 60: D+, D, and 59 ~ 0: F).

Honor System: You are expected to adhere to the Honor System of the University of Mary Washington. You may not use old exams from prior semester. In particular, you should not consult books, notes, or other students’ work on exams.

Progress Report: A grade D+, D, or F will be entered as unsatisfactory.

Disabilities: If you need accommodations for any type of disability, please contact the Office of Disability Resources in Lee Hall 401, or call 654-1266.

Tentative course schedule:

<table>
<thead>
<tr>
<th>Dates</th>
<th>Tuesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/24 - 8/28</td>
<td>Introduction</td>
<td>Section 1.2</td>
</tr>
<tr>
<td>8/31 – 9/4</td>
<td>Sections 1.3 &amp; 1.4</td>
<td>Section 1.5</td>
</tr>
<tr>
<td>9/7 – 9/11</td>
<td>Sections 2.2 &amp; 2.3</td>
<td>Section 2.3</td>
</tr>
<tr>
<td>9/14 – 9/18</td>
<td>Section 2.3 (Project Description)</td>
<td>Section 2.4</td>
</tr>
<tr>
<td>9/21 – 9/25</td>
<td>MATLAB</td>
<td>MATLAB</td>
</tr>
<tr>
<td>9/28 – 10/2</td>
<td>Section 2.5</td>
<td>Sections 2.5.4, 3.1, &amp; 3.2</td>
</tr>
<tr>
<td>10/5 – 10/9</td>
<td>Presentation</td>
<td>Section 3.3</td>
</tr>
<tr>
<td>10/12 – 10/16</td>
<td>No class</td>
<td>Sections 3.4 &amp; 3.5</td>
</tr>
<tr>
<td>10/19 – 10/23</td>
<td>Section 6.2</td>
<td>Section 6.3</td>
</tr>
<tr>
<td>10/26 – 10/30</td>
<td>Section 6.3</td>
<td>Section 6.3 (Project Description)</td>
</tr>
<tr>
<td>11/2 – 11/6</td>
<td>Sections 7.1, 7.2, &amp; 7.3</td>
<td>Section 8.2</td>
</tr>
<tr>
<td>11/9 – 11/13</td>
<td>Sections 8.2 &amp; 8.3</td>
<td>Section 8.3 (Project Discussion)</td>
</tr>
<tr>
<td>Date Range</td>
<td>Content</td>
<td>Date Range</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>11/16 – 11/20</td>
<td>Sections 4.2 &amp; 4.3</td>
<td>11/23 – 11/27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/30 – 12/4</td>
<td>Research Talk</td>
<td></td>
</tr>
</tbody>
</table>

**Important Dates:**

- Friday, Aug. 28: Last day to add courses.
- Friday, Sept. 11: Last day to drop a course without a grade of W.
- Friday, Oct. 23: Last day to withdraw from a course without a grade of F; Last day to change to/from a pass/fail grade.

**Changes to the syllabus:** I do not anticipate changes to the above, however, should the need arise, course policies will be updated when needed and any changes will be announced in class.