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| Department | | Mathematics | College | Science | |
| Date | October 11, 2021 | | | |

**FORM A**

**ADMINISTRATIVE**

**USE ONLY**

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|  | UACM |  | UPRE |
|  | UREL |  | NOLIJ |
|  | CAT |  |  |

Effective: \_\_\_\_\_\_\_\_\_\_\_

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| Proposed Course Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rubric & No. | 7382 | | Title | Introduction to Applied Mathematics | | | | | | | | | | | | | | | | | | | | | | | | | |
| Short Title (≤ 19 characters) | | | | | I | N | T | R | O |  | | A | P | P | L | | I | E | D | |  | M | | | A | | T | H |  |
| Semester Hours of Credit | | | | | 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| If combination course type, # hrs. of **CREDIT** for | | | | | Lecture: \_\_\_ | | | | | | | Lab/Sem/Rec: \_\_\_ | | | | | | | | | | | | | | | | | |
| Repeat Credit Max. (if repeatable): | | | | | | credit hours | | | | | Graduate Credit? | | | | | X Yes | | | | | | | No | | | | | | |
| Credit will not be given for this course and: | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | |
| Course Type (Indicate **CONTACT** hours in the appropriate course type.) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lecture 3 | Lab | | Seminar | Recitation | | Lec/Rec       / | | | Lec/Sem       / | | | Lec/Lab       / | | | | Res/Ind | | | | Clin/Pract | | | | | | Intern | | | |
| Maximum enrollment per section: (use integer, e.g. 25 not 20-30) | | | | | | | | | | | 99 | | | | | | | | | | | | | | | | | | |
| Grading System: | | Letter Grade X | | | | Pass/Fail | | | | | | Final Exam:\*\* | | | | | Yes X | | | | | | | No | | | | | | |
| \*\*(**Attach justification if the proposed course will not hold a final exam during examination week.)\*\*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Course Description:**  **(Concise catalog statement exactly as you wish it to appear in the *General Catalog***  Math 7382 Introduction to Applied Mathematics (3)  *Prereq.: Credit or registration in Math 7311.* This course gives an overview of the modeling and analysis of the equations of mathematical physics, such as electromagnetics, fluids, elasticity, acoustics, quantum mechanics, etc.  It serves as a fundamental course in Applied Mathematics that gives a balance of breadth and rigor in developing mathematical analysis tools, such as measure theory, function spaces, Fourier analysis, operator theory, and variational principles, for understanding many differential and integral equations of physics. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| Budget Impact (iF ANSWER TO ANY QUESTION IS “YES”, ATTACH EXPLANATION. | | | |
| If this course is approved, will additional staff be needed? | | Yes | No X |
| Will additional space, equipment, special library materials or other major expense be involved? | | Yes | No X |
| Academic Affairs Approval: |  | (Date) | |
| Attachments (attach the following to your proposal) | | | |
| **JUSTIFICATION: Justification must explain why this course is needed and how it fits into the curricula. Will the course duplicate other courses?**  **SYLLABUS: Including 14 week outline of the subject matter; titles of text, lab manual, and/or required readings; grading scale and criteria**  **(For 4000-level, specify graduate student grading criteria if requirements differ for graduate and undergraduate students).** | | | |

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| Approvals | | | |
| Department Faculty Approval Date |  | College Faculty Approval Date |  |

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Department Chair Signature (date) College Dean Signature (date)

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Graduate Dean Signature (date) Chair, FS C&C Committee (date)

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College Contact E-mail Academic Affairs Approval (date)

**Justification for MATH 7382, Introduction to Applied Mathematics**

This course arose out of a need for PhD students who pursue applied mathematics to have curricular guidance early in their studies. The course introduces students to equations and problems encountered in applications, concentrating on the partial differential equations of physics. It provides a foundation for the various mathematical areas and methods used to study these problems so that students can make informed curriculum choices. This course is being piloted this semester (Fall 2021) under the heading of a topics course (viz., Math 7380, Seminar in Functional Analysis) with eight enrolled students.

This course is aimed at mathematics students and does not overlap course in other departments, despite it’s being a course on applied mathematics. The course pays specific attention to the rigorous techniques and sophisticated theories that are central to the role of a mathematician in solving applied problems, and it cannot be replaced by a course in the physical sciences.

**SAMPLE SYLLABUS**

**Introduction to Applied Mathematics  
MATH 7382, Fall 2021  
Professor Stephen Shipman**

**Course Description:** This course gives an overview of the modeling and analysis of the equations of mathematical physics, such as electromagnetics, fluids, elasticity, acoustics, quantum mechanics, etc. It serves as a fundamental course in Applied Mathematics that gives a balance of breadth and rigor in developing mathematical analysis tools, such as measure theory, function spaces, Fourier analysis, operator theory, and variational principles, for understanding many differential and integral equations of physics.

**Prerequisite:** Credit or registration in MATH 7311.

**Office:** 223 Lockett Hall

**Contact information:**

Telephone: 578-1674   
Email: shipman@lsu.edu

**Office hours:** Tuesday 3:00-4:30 and Thursday 9:00-10:30; also by appointment. **Textbook:** An Introduction to Partial Differential Equations (second edition) by M Renardy and RC Rogers (Springer 2005)

**15 Week Course Outline:**

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| Weeks 1-4 | Text Chapter 1,  Lecture notes | The first four weeks will introduce some of the differential equations of mathematical physics, including the Maxwell equations of electromagnetics and other wave equations, the equations of fluids, Schrödinger equations of quantum mechanics, and several others, depending on the slant of the instructor. This material will draw from other sources besides the course textbook, including the instructor’s notes.  Embedded in this introduction will be descriptions of specific problems that are of interest to researchers and indications of the kind of mathematical tools that are used to solve them, including “weak” derivatives. |
| Week 5 | Text Chapter 4, Text Sec. 1.2 | Maximum principles for elliptic partial differential equations (PDE).  Variational principles for elliptic PDE will be illustrated with the Laplace and Poisson equations, with a discussion of why functional spaces are important. |
| Weeks 6-7 | Text Chapter 5 | Distributions and the Fourier transform. This chapter makes rigorous the notion of weak derivatives of all orders, and it extends the domain of applicability of the Fourier transform. |
| Weeks 8-9 | Text Ch. 6-7 | Function Spaces. The spaces of functions, using different norms of measurement, which were alluded to in weeks 1-4 are rigorously defined. Special attention is paid to Sobolev spaces, especially the trace and embedding theorems. |
| Week 10 | Text Chapter 8 | Operator Theory. This chapter parses linear differential equations in the context of operators in appropriate function spaces and introduces the ideas of spectral theory in applied mathematics. |
| Weeks 11-12 | Text Ch. 9-10 | Elliptic Equations. These two chapters apply the techniques learned in weeks 5-10 to solving linear and nonlinear elliptic PDEs of physics. |
| Weeks 13-14 | Text Chapter 11 | Energy methods. Evolution equations are of parabolic and hyperbolic type, and this chapter introduces the powerful method of controlling energies to analyze how PDE systems evolve over time. |
| Week 14-15 | Text Chapter 12 | Semigroup methods; or a survey of numerical analysis in numerical computation of PDE solutions.  Final Exam |

LSU letter grades will be assigned according to this table. The end-of-semester numerical grades are rounded to whole numbers (for example, 94.49 = 94, 94.50 = 95):

A+ 98-100  
A 94-97  
A- 90-93  
B+ 87-89  
B 84-86  
B- 80-83  
C+ 77-79  
C 71-76  
C- 68-70  
D+ 65-67  
D 62-64  
D- 58-61  
F 57 and below

Final grades will be computed from the following activities:

**GRADING Scheme:**

Bi-weekly assignments 80%, Final exam 20%.

**Description of Activities that will be Graded:**

**Assignments**

The grade on the assignments is calculated as an average of the individual percent grades. The assigned problems will come from the textbook or the instructor’s notes. Due dates are given on the course website.

**Final Exam**

A comprehensive final exam will be taken at the time and date published in the LSU scheduling book.

**Expectations**

LSU’s general policy states that for each credit hour, the studen) should plan to spend at least two hours working on course related activities outside of class. Since this course is for three credit hours, you should expect to spend a minimum of sixhours outside of class each week working on assignments for this course. For more information see: http://catalog.lsu.edu/content.php?catoid=12&navoid=822.

**LSU student code of conduct**

The LSU student code of conduct explains student rights, excused absences, and what is expected of student behavior. Students are expected to understand this code as described here: http://www.lsu.edu/students/saa/students/codeofconduct.php. Any violations of the LSU student code will be duly reported to the Dean of Students.

**Disabilities**

Louisiana State University is committed to providing reasonable accommodations for all persons with disabilities. The syllabus is available in alternate formats upon request.

If you have a disability that may have some impact on your work in this class and for which you may require accommodations, please see a [staff member in Disability Services](https://www.lsu.edu/disability/about/staff.php) so that such accommodations can be considered. Students that receive accommodation letters, please meet with me to discuss the provisions of those accommodations as soon as possible.