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| Department | | Mathematics | College | Science | |
| Date | 10/16/2021 | | | |

**FORM A**

**ADMINISTRATIVE**

**USE ONLY**

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

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

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| Proposed Course Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rubric & No. | 7560 | | Title | Riemannian Geometry | | | | | | | | | | | | | | | | | | | | | | | | | |
| Short Title (≤ 19 characters) | | | | | R | I | E | M | A | N | | N | I | A | N | |  | G | E | | O | M | | | E | | T | R | Y |
| Semester Hours of Credit | | | | | 3 hours | | | | | | | | | | | | | | | | | | | | | | | | |
| If combination course type, # hrs. of **CREDIT** for | | | | | Lecture: 3 | | | | | | | Lab/Sem/Rec: 0 | | | | | | | | | | | | | | | | | |
| 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 7560 Riemannian Geometry (3)  *Prereq.: MATH 7550*. Introduction to Riemannian geometry, the study of smooth manifolds endowed with Riemannian metrics. Topics include Riemannian metrics, connections, geodesics, curvature, Jacobi fields, completeness, spaces of constant curvature, and calculus of variations, followed by theorems that relate curvature, topology, and analysis. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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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 7560 Riemannian Geometry**

This course has been taught as a MATH 7590 Topics course in Spring 2015, Spring 2018, and Fall 2020. A plan has been in place since 2018 to offer this course and Algebraic Topology Math 7520 in alternating years. (Previously Algebraic Topology was offered every year.)

Over the past ten years, the makeup of the geometry and topology faculty has shifted. This course is designed to better reflect the research being done by the group and to better prepare geometry/topology Ph.D. students for their research.

The creation of a course number for Riemannian Geometry will not impact the requirements of students outside of mathematics. The goal is to formalize preexisting changes in the training regime of graduate students in geometry/topology.

**Sample Syllabus**

**MATH 7560 - Fall 2021  
Riemannian Geometry  
Professor Mike Tiger, VI**

**Course Description:** Introduction to Riemannian geometry, the study of smooth manifolds endowed with Riemannian metrics. Topics include Riemannian metrics, connections, geodesics, curvature, Jacobi fields, completeness, spaces of constant curvature, and calculus of variations, followed by theorems that relate curvature, topology, and analysis.

**Prerequisite:** MATH 7550.

**Office:** 128 Allen Hall

**Contact information:**

Telephone: 578-1212   
Email: mtiger@lsu.edu

**Office hours:  
  
Textbook:** Riemannian Geometry by Manfredo Perdigão do Carmo

**15 Week Course Outline:**

|  |  |  |
| --- | --- | --- |
| Week 1 | Chapter 0 | Smooth manifold, tangent space, orientation |
| Week 2 | Chapter 1 | Vector fields, Lie bracket, Riemannian metric |
| Week 3 | Chapter 2 | Affine Connection |
| Week 4 | Chapter 2 | Levi-Civita connection |
| Week 5 | Chapter 3 | Geodesics, geodesic flows and fields |
| Week 6 | Chapter 4 | Riemann curvature, sectional curvature |
| Week 7 | Chapter 4 | Ricci and scalar curvature, Bianchi Identity |
| Week 8 | Chapter 5 | Jacobi equation, Jacobi field |
| Week 9 | Chapters 6 & 7 | Completeness, Hopf-Rinow, Hadamard |
| Week 10 | Chapter 8 | Space forms |
| Week 11 | Chapter 9 | Variations of Energy, first and second variations |
| Week 12-14 | Chapter 9-12 | Projects: Poincaré-Hopf theorem, Bonnet-Myers theorem, Rauch Comparison theorem, Morse theory, Preissman theorem |
| Week 15 | Review | Final Exam |

LSU letter grades will be assigned according to this table. Your 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:**

Weekly Homework 50%, Capstone Project 30%, Final exam (cumulative) 20%

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

**Homework**

Homework will be assigned from the chapter problems in the textbook. The homework grade is calculated as an average of the individual percent grades. Due dates are listed with further instructions on the course Moodle site.

**Capstone Project**

A topic (see Projects in Weeks 12-14) will be assigned to each student to present in class. The grade will be based upon the preparation, clarity, and delivery of the presentation.

**Final Exam**

A comprehensive final exam will be taken at the time and date published in the LSU scheduling book. The exam grade will be computed as % correct.

**Expectations**

LSU’s general policy states that for each credit hour, you (the student) 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 six** hours 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.