

## MAT 6932 & MAT 4930 SYLLABUS – FALL, 2022

**Lectures Time and Location:** Monday, Wednesday, Friday 7th Period (1:55pm - 2:45pm), Little Hall Buiding, Room 219

**Instructor:** Luca F. Di Cerbo

**Instructor's Office:** Little Hall 476

**Instructor's Email:** ldicerbo@ufl.edu

**Office Hours:** Monday and Wednesday 4th Period (10:40 am - 11:30 am), in person office hours in Little Hall 476 (Instructors office). I am also available on Zoom by appointment.

**COURSE TITLE:** Geometric Analysis.

**PREREQUISITES:** Linear Algebra and Calculus 3.

**COURSE OBJECTIVES:** You will learn the basic theory of harmonic functions on Riemannian manifolds together with the foundational aspects of modern Geometric Analysis. You will be able to communicate such concepts in writing and through short oral presentations. This course will expose you to mathematics which is crucial in many other branches of analysis, geometry, topology, and also applications such as general relativity, string theory, and image analysis.

**MAIN TEXTBOOK:**

- **Title:** Eigenvalues in Riemannian Geometry
- **Author:** Isaac Chavel
- **ISBN:** 9780121706401
- **Publication date and edition:** November 7th, 1984, 2nd edition

**COURSE DESCRIPTION:** This class is an introductory course in geometric analysis at the graduate level and advanced undergraduate level. Geometric analysis plays a uniquely central role in modern mathematics, and it experienced a tremendous growth in the last forty years. It also figures prominently in many other areas of mathematics, such as mathematical general relativity, mathematical string theory, and geometric topology. It is also essential in many applications; e.g., image analysis and geometric

data analysis. More specifically, we will first introduce the foundational aspects of geometric analysis on manifolds. In particular, we will define the Laplace operator on a Riemannian manifold by using the Riemannian metric and the associated Levi-Civita connection. After reviewing some of the most important features of harmonic functions on the flat Euclidean space, we then develop the modern theory of harmonic functions on Riemannian manifolds. This will include the proof of the non-existence of non-constant  $L^2$ -harmonic functions on complete Riemannian manifolds (a celebrated result of **S.-T. Yau, 1976**).

**COURSE SCHEDULE:** We will follow the progression of topics listed in the Course Description section. This corresponds to Chapters I-VI in the main reference book. For a more detailed description of the schedule I refer you to the e-learning Canvas page for this class.

**ATTENDANCE POLICY, CLASS EXPECTATIONS, MAKEUP POLICY:** I consider attendance to be a crucial part of the instructions for this class, and you should actively participate to our in person sessions. Students shall be excused from class following the UF guidelines. Also, due to the unprecedented circumstances we still face this semester, I will try to be flexible following a case-by-case approach when it comes to attendance, late and make-up work. Excused absences must be consistent with university policies in the Graduate Catalog and require appropriate documentation. Additional information can be found here: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

**EVALUATION OF GRADES:**

- Homework, and attendance (70%).
- Final presentation (30%).

**GRADING POLICY:** The grading scale is from 0 to 100 points. The final grade is based on homework, attendance, and a final presentation. Grading in this class is consistent with UF policies available at: <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>

- Policy on Late and Make-up Work: Students shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith with prior notification to the instructor. Students shall be permitted a reasonable amount of time to make up the material or activities covered in their absence. Students shall not be penalized due to absence from class or other scheduled academic activity because of religious observances. Students who are absent from classes or examinations because of illness should contact their instructors. The Student Health Care Center (SHCC) <https://shcc.ufl.edu/> can provide a medical excuse note only if

their providers are involved in the medical care of a student who must be absent from class for three or more days for medical reasons. A student who has a medical reason that results in fewer than three days of absence from class should talk with his/her professor rather than ask for an excuse note from the SHCC. If a professor subsequently requires a note for a medical absence of fewer than three days, then the professor must provide the SHCC with a written request on UF departmental letterhead.

- Grade Return Timing: Each homework will be graded within 3 to 5 business days. Moreover, within the same time frame I will communicate the corresponding grade via a Canvas email (preferred option for security reasons).
- Point Range for this Class: A: 90% 100%, A-: 85% 89%, B+: 80% 84%, B: 75% 79%, B-: 70% 74%, C+: 66% - 69%, C: 60% 65%, C-: 56% 59%, D+: 52% 55%, D: 48% 51%, D-: 45% 47%, F: 0% 44%.

#### **IN-CLASS RECORDING:**

- Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.
- A class lecture is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.
- Publication without permission of the instructor is prohibited. To publish means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without

written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

**STUDENTS REQUIRING ACCOMMODATIONS:** Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.SYLLABUS5ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

**COURSE EVALUATIONS:** Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals at <https://gatorevals.aa.ufl.edu/>. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

**UNIVERSITY HONESTY POLICY:** UF students are bound by The Honor Pledge which states, We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: On my honor, I have neither given nor received unauthorized aid in doing this assignment. The Honor Code: (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

**COVID-19 STATEMENT:** In response to COVID-19, the following recommendations are in place to maintain your learning environment, to enhance the safety of our in-classroom interactions, and to further the health and safety of ourselves, our neighbors, and our loved ones.

- If you are not vaccinated, get vaccinated. Vaccines are readily available and have been demonstrated to be safe and effective against the COVID-19 virus. Visit [one.ufl](http://one.ufl) for screening / testing and vaccination opportunities.

- If you are sick, stay home. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 to be evaluated.
- Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work.

**DIVERSITY STATEMENT:** The Mathematics Department is committed to diversity and inclusion of all students. We acknowledge, respect, and value the diverse nature, background and perspective of students and believe that it furthers academic achievements. It is our intent to present materials and activities that are respectful of diversity: race, color, creed, gender, gender identity, sexual orientation, age, religious status, national origin, ethnicity, disability, socioeconomic status, and any other distinguishing qualities.