The Method of Extremal Metrics in Complex Analysis

MATH 5399-001 **Summer II 2016**

Course instructor: **Dr. Alexander Solynin**

MATH 115 **M-F** **12:00 – 1:50 pm**

Office hours: **M W T** **2:00 – 3:00 pm or by appointment**

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TEXT: Your lecture notes.

Complementary texts: (1) Conformal invariants. Topics in geometric function theory. Reprint of the 1973 original; 2010, by Lars V. Ahlfors; (2) Univalent Functions and Conformal Mapping*, Springer-Verlag. Berlin,* 1958 by James A. Jenkins; (3) Quadratic Differentials. Springer-Verlag*, Berlin,* 1984, by Kurt Strebel.

- Course Description: This is an introductory course to the method of Extremal Metrics and Moduli of Families of Curves which are useful tools in a wide variety of areas. The method is based on the relations between the length of curves belonging to specific homotopy classes and the areas of the domains filled out by them. The original form of this method, the so-called Grötzsch's strip method, which is an essential refinement of the arguments connecting length and area, operates with the characteristic conformal invariants of doubly-connected domains and quadrangles. The modern form of the method based on the concept of the extremal length was developed by L.V. Ahlfors, A. Beurling, J.A. Jenkins, K. Strebel, G.V. Kuz'mina, and others. This instructor also contributed to this area.

In this class, we will study basic properties of extremal lengths and moduli of families of curves. Then we will discuss Jenkins theory of extremal decompositions of surfaces into disk domains and ring domains, which have been found to be very useful in the theory of extremal problems of geometric function theory (analysis), the theory of minimal surfaces (geometry), and the conformal string theory (theoretical physics). Our third goal will be to discuss several applications of this theory to some particular problems from Complex Analysis.

The prerequisite for the course is a one year course in Complex Variable.

Learning Outcomes: Upon completion *Method of Extremal Metrics course* students will master concepts and theories of Extremal length and Moduli of families of curves.

The main emphasis will be given to applications of these theories to Extremal Problems for analytic functions, harmonic functions, and conformal mappings.

Methods for Assessment of Learning Outcomes: The expected learning outcomes for the course will be assessed through graded activities and ungraded activities. The graded activities include homework, quizzes, and research projects. The ungraded activities will be used to monitor your progress. A variety of these ungraded assessment techniques may be employed, including problems to be completed during class, direct questioning of students, answering students questions in class, one-minute classroom assessment techniques, and discussions during office hours.

Students with Disabilities: Any student who because of a disability may require special arrangements in order to meet course requirements should contact the instructor as soon as possible to make any necessary accommodations. Students should present appropriate verification from AccessTECH. No requirement exists that accommodations be made prior to completion of this approved university procedure.

Absence due to religious observance: The Texas Tech University Catalog states that a student who is absent from classes for the observance of a religious holy day will be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. Notification must be made in writing and delivered in person no later than 15th class day of the semester.

Absence due to officially approved trips: The Texas Tech University Catalog states that the person responsible for a student missing class due to a trip should notify the instructor of the departure and return schedule in advance of the trip. The student may not be penalized and is responsible for the material missed.

Academic Integrity: It is the aim of the faculty of Texas Tech University to foster a spirit of complete honesty and a high standard of integrity. There will no tolerance for cheating or plagiarism. Texas Tech University policies will be enforced in such cases.

STUDENT EVALUATION:

- Students are encouraged to work on their research projects related to the theory of *The Method of Extremal Metrics in Complex Analysis* and present results upon completion.

♦ **Final Exam (Optional)** **35 pts**

These 35 pts can be used to substitute for Research Project, Presentation of the Research project, and/or Homework but cannot be used as a substitute for Quizzes and Attendance.

♦ **Research Project + Presentation** **50 pts**

- **Homework**: **20 pts**
- **5 min Quizzes**: **25 pts**
- **Attendance**: **5 pts**

- **MAXIMAL TOTAL:** **100 pts**

GRADING PROCEDURE:

A - 90 - 100%
B - 80 - 89%
C - 70 -79%
D - 60 - 69%
F - ≤ 59%

OTHER INFORMATION:

Significant Dates/Events:

July 12	Classes begin.
August 10	**last day of Summer II 2016 classes**
August 11	**8:00 – 10:30 a.m. MATH 115 FINAL EXAM**