# The University of Texas – Rio Grande Valley
# Syllabus for Math 3350.90L: Intro to Math Proof Spring 2021
Online Asynchronous

## Contact information

**Instructor:** Dr. Eleftherios Gkioulekas, School of Mathematical and Statistical Sciences
**E-mail:** eleftherios.gkioulekas@utrgv.edu
**Web:** http://faculty.utrgv.edu/eleftherios.gkioulekas/
**Office hours:** MW 10:00-11:00 (online)
**Office location:** EMAGC 3.214

## Course information

**Prerequisites:** MATH 2318 with a grade of 'C' or better.
**Corequisites:** None.
**Course Description:** This course will prepare the student for advanced mathematics courses that require the writing of proofs. It reviews various elementary proof methods and the logical structure underlying them. It examines the formal definitions and basic properties of the mathematical structures that one encounters when constructing proofs, and it recounts famous theorems concerning these structures that every mathematician should know. Students are expected to construct non-routine mathematical proofs independently and to present their work in written form clearly and precisely. Substantial written work is required.
**Course modality:** This course will be delivered fully online. There will be no designated class meeting time for real-time instructor/student interaction, which gives you the flexibility to engage with the course materials as best fits your daily schedule. Your learning will be guided by the digital presentation of the course content (e.g., recorded lectures, presentations, outlines, notes) and scheduled assignments. Your instructors will provide you with feedback on assigned work, communicate with you electronically, and be available to meet as defined on this syllabus.

## Textbook

(1) E. Gkioulekas: "Lecture Notes on Introduction to Mathematics Proof", *Online Lecture Notes on Mathematics*, Edinburg, University of Texas Pan American (2009), 172 pp.
- Open Educational Resource
- This document can be downloaded as a pdf file, at no cost, from https://faculty.utrgv.edu/eleftherios.gkioulekas/Teaching/notes.html

## Outline of Topics

Week 1
- **Sets and Logic**

Propositions and truth tables
Boolean Algebra
Application to inequalities
Week 2
Sets – Definitions
Proving set properties
Week 3
Predicates and quantified statements
Quantified statements and Euclidean Geometry
Week 4
Indexed set collections
Defining sets by description
Week 5
Proof methodology with sets
**Exam 1**
- **Integers**

Definitions – odd and even integers

Week 6
Well-ordering principle
Divisibility
Week 7
Method of induction
**Exam 2**

- **Relations and Functions**
  Week 8
  Cartesian product
  Week 9
  Relations
  Week 10
  Equivalence relations and equivalence classes
- **Mappings and Functions**
  Week 11
  Basic definitions
  One to-one mappings/functions
- **Exam 3**
  Week 12
  Function Monotonicity
  Algebra and Properties of mappings/functions
  Week 13
  Mapping composition
  Inverse mappings
- **Exam 4**
  Week 14
  Cardinality
  Week 15
  Cardinality inequalities
  Cardinal numbers

**Pedagogical objectives and expectations**

The fundamental pedagogical objectives that students should strive for in every Mathematics course are:

(1) To understand, learn, and remember the formal and rigorous mathematical *definition* for every concept covered in the course.
(2) To understand, learn, and remember all the *theorems* and *propositions* that are applicable to previously defined concepts.
(3) To understand, learn, and practice the *methods* for applying theorems in the solution of routine problems, and to be able to creatively synthesize techniques to solve problems that are non-routine and may require creative thinking.
(4) To master *rigorous mathematical writing*, understand and use *logic and quantifier notation*, and realize and appreciate that every mathematical argument, from basic arithmetic, to advanced mathematics, with almost no exceptions, is a mathematical proof.
(5) To master the course material to a level of excellence that will ensure sustained success in more advanced mathematics courses.

To be successful in this course, it is expected that you should:

(1) Spend about 12 hours each week working homework problems, reviewing lecture notes, reading the textbook and online lecture notes, studying for exams, and seeking help from the tutors and instructor;
(2) Complete all homework problems, check the correctness of your work, and understand the methods and principles they illustrate;
(3) Master the designed course topics before each test, and if necessary, complete additional problems beyond those assigned and consult other sources if you find the assigned problems and text are insufficient;
(4) Recognize that mastery of the solution to a problem is not demonstrated by simply obtaining the correct numerical answer, but only by a clear, systematic, and detailed solution that traces the given information to the final numerical answer and that employs knowledge developed in this and previous courses;
(5) When you experience difficulty in the course, seek help from the tutors and instructor immediately;
(6) Attend class meetings regularly, pay attention, and do not hesitate to ask questions; and

(7) Write your solutions to homework, test, and quiz problems in an organized and legible way.

**Grading Policies**

- **Grading:** There will be 4 major exams, and a comprehensive final exam. The time and location of exams will be announced in class. Exams count for 80% and final exam for 20%of your grade. Combined, you get a numerical grade on a scale 0-20. Each exam question is graded on a 0-4 scale with $4 = A$, $3 = B$, $2 = C$, $1 = D$, $0 = F$. Combining all exams, as explained above, gives a weighted average score on a 0-20 scale. This score is then mapped to a letter grade as follows: A: 16-20; B: 12-16; C: 10-12; D; 7-10; F: 0-7. There will be no curve and no extra credit.
- **Explanation of grades:** Your exams are graded question by question on a 0-4 scale per question. Overall, if you are planning to take future Mathematics or STEM courses, I would like to see you score 3 or 4 on all questions on all major examinations. If you score less than that on any questions, it indicates weaknesses in understanding the material. You should be proactive about addressing these weaknesses.
- **Missed exams:** If a major exam is missed during an excused absence, your score for that exam will be replaced with your final exam score.
- **Homework:** Homework will be assigned, but will not be collected or graded. Nevertheless, it is crucial to do the homework as part of your preparation for the exams. To keep up, I recommend that **after every lecture you should solve the homework problems corresponding to the material covered on that day's lecture. Thus you need to work on a continuous basis!** Maintain a well-organized written record of your homework solutions by **writing the statement of each problem** (so that your document is stand-alone and can be read by itself), followed by your detailed solution, and clearly indicate the problem, section, and chapter number of the question. Most homework problems require more than simply writing the answer, and so you must write all steps of your solution and provide appropriate justification, as illustrated by the instructor's solved examples, as you would on a test. Write neatly and legibly, using rigorous mathematical notation. While you are encouraged to discuss homework problems with other students, tutors, your instructor, and other faculty, the write-up of your solutions must be your own work and not simply copied from another student or another source. Use a ring binder to collect your homework, and write with a black pen, as that will help you to later scan the ring binder as a PDF file, for possible future use, and as a form of backup. This will provide you with a readily available resource to prepare for tests and quizzes, as well as providing documentation of the homework problems should you have a question about a problem and seek help from the instructor or a tutor.
- **Make-ups:** There are no make-up exams. In the case of **excused** absences the final exam will be used as a make-up exam. **Each student MUST take the final exam at the scheduled date and time.** There will be no make-ups for the final exam, after the official final exam date!
- **Regrading policy:** If you believe that a mistake in grading has been made you may request that your paper be regraded. Such request must be submitted **in writing** within one week from the day the graded test has been returned in class, and must be accompanied by the original (unaltered) paper. If you make any changes to the paper your request will be denied. Please note that if you request regrading, all problems are subject to review. Thus, your overall grade may be increased or decreased.

**Other Policies**

- **Calendar of Activities:** Information regarding important dates, such as, first day of classes, holidays, last day to drop a class before it appears on the transcript (the census date), last day to drop or withdraw with a DR grade, and final exam schedule are available via the academic calendar, linked from the course website. Please be advised of these important dates, and feel

free to inquire with the instructor about any questions you may have with regard to the academic calendar.

- **Calculators:** The problems you will encounter in my exams will not require a calculator, and you are better served in the long-term by minimizing your dependence on calculators. Don't use the calculator to approximate roots, exponentials, logarithms, etc. Mathematical problems require **exact** answers. Approximations are reasonable **only** on application problems where the numbers given may be approximate themselves, and thus the best answer that can be deduced is unavoidably approximate.
- **Classroom Conduct:** Common courtesy requires that students arrive in class on time, and stay the entire class period. Turn your cellphones and pagers off. You are required to treat your classmate and instructor with respect and courtesy. Use of any electronic devices, except for calculators, is not allowed in class, and I reserve the option to remove you from the classroom without warning for any behaviour that I deem as disrespectful or disruptive. You agree to indemnify and hold harmless the professor with respect to all actions undertaken by the professor to enforce classroom conduct or to properly proctor exams. Taking my course implies your consent to this policy.
- **Revisions:** This syllabus may be revised at any time. The syllabus posted on the professor's course web site is the only copy guaranteed to incorporate all revisions that may be made under this policy and will thus supersede any other versions posted on other university websites.
- **Mandatory Course Evaluations:** Students are required to complete an ONLINE evaluation of this course, accessed through your UTRGV account (http://my.utrgv.edu); you will be contacted through email with further instructions. Students who complete their evaluations will have priority access to their grades.
- **Students with disabilities:** Students with a documented disability (physical, psychological, learning, or other disability which affects academic performance) who would like to receive academic accommodations should contact Student Accessibility Services (SAS) as soon as possible to schedule an appointment to initiate services. Accommodations can be arranged through SAS at any time, but are not retroactive. Students who experience a broken bone, severe injury, or undergo surgery during the semester are eligible for temporary services.
  - *Pregnancy, Pregnancy-related, and Parenting Accommodations:* Title IX of the Education Amendments of 1972 prohibits sex discrimination, which includes discrimination based on pregnancy, marital status, or parental status. Students seeking accommodations related to pregnancy, pregnancy-related condition, or parenting (reasonably immediate postpartum period) are encouraged to contact Student Accessibility Services for additional information and to request accommodations.
  - *Student Accessibility Services – Brownsville Campus:* Student Accessibility Services is located in 1.107 in the Music and Learning Center building (BMSLC) and can be contacted by phone at (956) 882-7374 or via email at ability@utrgv.edu.
  - *Student Accessibility Services – Edinburg Campus:* Student Accessibility Services is located in 108 University Center (EUCTR) and can be contacted by phone at (956) 665-7005 or via email at ability@utrgv.edu.
- **Scholastic dishonesty:** As members of a community dedicated to Honesty, Integrity and Respect, students are reminded that those who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and expulsion from the University. Scholastic dishonesty includes but is not limited to: cheating, plagiarism (including self-plagiarism), and collusion; submission for credit of any work or materials that are attributable in whole or in part to another person; taking an examination for another person; any act designed to give unfair advantage to a student; or the attempt to commit such acts. Since scholastic dishonesty

harms the individual, all students and the integrity of the University, policies on scholastic dishonesty will be strictly enforced (Board of Regents Rules and Regulations and UTRGV Academic Integrity Guidelines). All scholastic dishonesty incidents will be reported to Student Rights and Responsibilities.

- **Sexual misconduct and mandatory reporting:** In accordance with UT System regulations, your instructor is a "Responsible Employee" for reporting purposes under Title IX regulations and so must report to the Office of Institutional Equity & Diversity (oie@utrgv.edu) any instance, occurring during a student's time in college, of sexual misconduct, which includes sexual assault, stalking, dating violence, domestic violence, and sexual harassment, about which she/he becomes aware during this course through writing, discussion, or personal disclosure. More information can be found at www.utrgv.edu/equity, including confidential resources available on campus. The faculty and staff of UTRGV actively strive to provide a learning, working, and living environment that promotes personal integrity, civility, and mutual respect that is free from sexual misconduct, discrimination, and all forms of violence. If students, faculty, or staff would like confidential assistance, or have questions, they can contact OVAVP (Office for Victim Advocacy & Violence Prevention) at 665-8287, 882-8282, or OVAVP@utrgv.edu.

**Student Learning Outcomes**

After completing this course students will be able to

(1) Master the basic techniques and strategies used in mathematical proofs and understand the logical structure of mathematical proofs and associated constructs.
(2) Write mathematical arguments in clear, precise, and correct English.
(3) Understand sets, boolean logic, and quantified statements, and how to prove set theory statements involving set relations, properties of set operations, and indexed set collections.
(4) Write proofs involving odd/even integers, the well-ordering principle, divisibility, and the method of induction.
(5) Learn the definition and properties of the cartesian product, relations, equivalence relations, and equivalence classes.
(6) Write proofs about mappings and functions, specifically studying one-to-one mappings, function monotonicity, algebra and properties of functions, mapping composition, and the mapping inverse.