The University of Texas – Rio Grande Valley
Syllabus for Math 2413.02: Calculus I Summer I 2019
EMAGC 1.418 MTWRF 08:00-10:00

Contact information

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Course information

Prerequisites: MATH 2412 with a grade of 'C' or better; or passing the Precalculus Exemption Test administered by the School of Mathematical and Statistical Sciences.
Corequisites: None.
Course Description: Topics include limits, derivatives, antiderivatives, and definite integrals of algebraic and transcendental functions. Applications of these topics will be emphasized.

References

(1) J. Stewart, "Essential Calculus" (early transcendentals), 2nd edition, Thomson Brooks/Cole, 2012
(2) E. Gkioulekas: "Lecture Notes on Calculus 1", *Online Lecture Notes on Mathematics*, Edinburg, University of Texas Pan American (2009), 364 pp.
(3) Z. Hannan: "wxMaxima for Calculus I", Solano Community College (2015), 158pp
(4) E. Gkioulekas: "On equivalent characterizations of convexity of functions", *International Journal of Mathematical Education in Science and Technology* **44** (2013), 410-417
(5) E. Gkioulekas: "Zero-bounded limits as a special case of the squeeze theorem for evaluating single-variable and multivariable limits", *International Journal of Mathematical Education in Science and Technology* **44** (2013), 595-609
(6) E. Gkioulekas: "Generalized local test for local extrema in single-variable functions", *International Journal of Mathematical Education in Science and Technology* **45** (2014), 118-131

Outline of Topics

- **Review of Functions**
  Preliminaries
  Functions and Domain
- **Limits**
  Definition of limit
  Limits and Operations
  Side limits
  Limits at infinity
  Trigonometric limits
  Exam 1
  Continuity
  Intermediate Value Theorem
  Asymptotes
- **Derivatives**
  Differentiability – tangent line problem
  Derivative function
  Chain rule
  The quotient rule
  Trigonometric derivatives
- **Differential calculus**
  Definitions: Monotonicity, min/max
  Fermat, Rolle, and Mean Value Theorem
  Monotonicity/Local min/max
  Concavity
  Exam 2
- **Exponentials and Logarithms**
  Approximation sequences
  Definition of powers – Napier constant

Natural exponential function
Inverse functions
Natural logarithm
General exponential function
General logarithm

- **Other inverse functions**
  Inverse trigonometric functions
  Hyperbolic functions
  Inverse hyperbolic functions
  De L'Hospital's theorem
  Exam 3
- **Integrals**
  Definition of integrals
  Fundamental theorem of calculus. Part 1
  Fundamental theorem of calculus. Part 2
  Method of substitution

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 3 major exams, and a comprehensive final exam. The time and location of exams will be announced in class. Exams count for 75% and final exam for 25%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.
- **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.
- **Attendance Policy:** Attendance will be taken during most class meetings. It is important to sign in the sign-up sheet if you are present. **The instructor has the prerogative to drop any student with four (4) or more unexcused absenses.** Two (2) tardies will count as one (1) unexcused absense. A tardy is defined as entering the class late or leaving the class early. **If you miss any major exam, you will be dropped from the course.**
- **How to Excuse an Absense:** To excuse an absense, you must submit **in writing** the "Notification of a Scheduled Excused Absense form" stapled **with documentation**, before the date you will be absent, or no more than **three (3)** bussiness days after the date. The form should be submitted in person in class, during office hours, or via the Mathematics Department secretary. The form can be downloaded from the course web page. If a major exam is missed during an excused absense, your score for that exam will be replaced with your final exam score. UTRGV's attendance policy excuses students from attending class if they are participating in officially sponsored university activities, such as athletics; for observance of religious holy days; or for military service.
- **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

- **Course web page:** A course web page will be used to distribute the syllabus, assigned homework, solutions to exams, a copy of my lecture notes, and any other relevant material. A link to that page will be available from my main page at `http://faculty.utrgv.edu/eleftherios.gkioulekas/`
- **Exam pick-up:** If you do not pick up your test paper within 1 week from the test date, I will throw away your paper and keep record of your test score.
- **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 at `http://my.utrgv.edu`, at the bottom of the screen, prior to login. 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.
- **Extra Help:** You are strongly encouraged to form a study group with two or three of your classmates. The group should have no more than 4 students. The group will serve to help each other in doing homework, studying for tests, and whenever possible, teaching each other. The idea is to help each other keep up with the class and hopefully, be successful.
  (1) Contact your instructor during their office hours.
  (2) Get free Math tutoring from Learning Assistance Center (LAC) building in Room 114 phone # 665-2532. (Edinburg Campus)
  (3) Get free Math tutoring from Math Lab in Math building (MAGC) in room MAGC 1.106 (Edinburg Campus)
  (4) Visit the Math Tutoring Lab at SETB 1.408 (Brownsville Campus)
  (5) Visit the Math and Natural Sciences Learning Center at Cavalry Hall; Phone number: (956) 882-7058, (956) 882-8208 (Brownsville Campus)
- **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.

- **Disability Access Statement:** 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 suffer 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 Cortez Hall Room 129 and can be contacted by phone at (956) 882-7374 (Voice) or via email at ability@utrgv.edu. **Edinburg Campus:** Student Accessibility Services is located in 108 University Center and can be contacted by phone at (956) 665-7005 (Voice), (956) 665-3840 (Fax), or via email at ability@utrgv.edu.
- **Academic integrity:** 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, 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 the Dean of Students.
- **Sexual harassment, discrimination, and violence**: In accordance with UT System regulations, your instructor is a "responsible employee" for reporting purposes under Title IX regulations and so must report any instance, occurring during a student's time in college, of sexual assault, stalking, dating violence, domestic violence, or 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 and discrimination.

Student Learning Outcomes

After completing this course students will:

(1) Understand the concept of a function and be able to find the default domain of explicitly defined functions
(2) Understand the definition and properties of limits and be able to evaluate limits using rigorously written mathematical arguments.
(3) Apply limits to analyze the continuity of functions, and to locate all asymptotes to a function using rigorously written mathematical arguments,
(4) Understand the definition and properties of derivatives and be able to evaluate the derivatives of functions

(5) Understand the Bolzano theorem, the Intermediatehe Value theorem, the Fermat theorem, the Rolle theorem, and the Mean Value theorem, and their applications.
(6) Apply derivatives to determining the monotonicity and convexity of functions as well as to locating the local min, local max, and inflection points of the graph of the function, and to evaluating limits using the De L'Hospital theorem.
(7) Understand the definition and properties of the Riemann integral, the Fundamental theorem of Calculus, and the method of substitution and apply them to differentiating functions defined by integrals and evaluating definite and indefinite integrals of functions.

Mathematics Major Student Learning Outcomes

Students completing the B.S. program in Mathematics will:

(1) Demonstrate in-depth knowledge of Mathematics, its scope, application, history, problems, methods, and usefulness to mankind both as a science and as an intellectual discipline.
(2) Demonstrate a sound conceptual understanding of Mathematics through the construction of mathematically rigorous and logically correct proofs.
(3) Identify, formulate, and analyze real world problems with statistical or mathematical techniques.
(4) Utilize technology as an effective tool in investigating, understanding, and applying mathematics.
(5) Communicate mathematics effectively to mathematical and non-mathematical audiences in oral, written, and multi-media form.
(6) Demonstrate an appreciation of and enthusiasm for lifelong scientific inquiry, learning, and creativity.

Core Mathematics Student Learning Outcomes

Students finishing a core curriculum course will be able to demonstrate the following objectives:

(1) CRITICAL THINKING (CT) is a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion. This definition meets the THECB's direction that critical thinking includes creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information; and is aligned with the UTRGV's SLO for critical thinking skills.

    Students will learn to approach symbolic, geometric and arithmetic problems form an abstract perspective using multiple representations of problems - geometric and algebraic; quantitative and qualitative. Furthermore, a significant portion of the course will focus students on the application of mathematical concepts to aid in critical analysis of a variety of problems from other subjects and areas.

    Student learning objectives 1, 2, 3, and 4 align with this core objective. They will be assessed through specific questions on the tests used in the course or by a special assignment.
(2) COMMUNICATION SKILLS (COM) include the development, expression, and revision of ideas through the effective use of language (writing, reading, speaking, and listening) across a variety of forums. Communication involves learning to work in many genres and styles while using different technologies, can result in mixing texts, data, and/or images, and develops through diverse experiences across the curriculum. This definition meets the THECB's direction that communication skills include effective written, oral, and visual communication; and is aligned with UTRGV's SLO for communication skills.

    A strong focus of this course is to develop in students the ability to discuss mathematical ideas with fluency to both experts in mathematics and those with less experience. For many problems the process of the solution is as or more important than the solution itself, making communication a natural skill developed by the course.

Student assessments (both summative and formative) used for student learning objectives 1, 2, 3, and 5 will address the development of students' communications skills in the course. Communication skills will be assessed, for example through oral presentations/demonstrations, or pre-recorded video demonstrations or a special assignment.

(3) EMPIRICAL AND QUANTITATIVE SKILLS (EQS), which involve numeracy or quantitative reasoning, include competency in working with numerical data and mathematical reasoning. Individuals with strong mathematical skills possess the ability to reason and solve quantitative problems from a wide array of authentic contexts and everyday life situations. They interpret data and results and can create conjectures and arguments supported by quantitative evidence and/or mathematical reasoning, which they can clearly communicate in a variety of formats (using words, tables, graphs, and/or equations as appropriate). This definition meets the THECB's direction that empirical and quantitative skills include applications of scientific and mathematical concepts; and is aligned with UTRGV's SLO for empirical and quantitative skills.

The course centers on the empirical and quantitative skills objective, which permeates almost every topic included in the course and course objectives. These will be assessed through specific questions on the tests used in the course or by a special assignment.

CALCULUS 1 HOMEWORK

- This homework is based on: J. Stewart, "Essential Calculus" (early transcendentals), Thomson Brooks/Cole, 2012
- 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.** Do the assigned reading and problems in the specified order.
- CAL1.1, etc. refer to the problems given in the online lecture notes. These notes are available at the course website.
- Problems indicated "for fun" are for math majors.

Preliminaries

- **Sets and Mappings**
  Read lecture notes
- **Functions and Domains**
  Read §1.1, §1.2
  Read lecture notes
  §1.1: 25-29, 33-35 (no sketching; only the domain)
  CAL1.1: 1,2

Limits

- **Definition of limit**
  Read lecture notes
  Read §1.3 (ignore the intuitive definition of the limit)
  CAL1.2: 1
- **Limits and Operations**
  Read §1.4
  §1.4: 11-28, 37-42
  CAL1,2: 2,3,4
- **Side limits**
  Read lecture notes
  Read §1.6
  §1.6: 13,14,15, 16, 17, 18
  CAL1.2: 5
- **Limits at infinity**
  §1.6: 19-27, 30-33
  CAL1.2: 6-10
- **Trigonometric limits**
  Read lecture notes
  Read §1.4
  §1.4: 33-36,49-56
  CAL1.2: 11,12
- **Continuity**
  Read §1.5
  §1.5: 29,30 ,33, 34
  CAL1.2: 13,14,15
  §1.5: 39-42, 43-44 (do only part (a))
  CAL1.2: 16-23
- **Asymptotes**
  Read lecture notes
  §1.6: 34, 35, 36 (no graphing calculator; find all asymptotes)
  CAL1.3: 1,2

Derivatives

- **Tangent problem–definitions**
  Read §2.1, §2.2
  §2.1: 3-6,49,50
  §2.2: 21-27,45,49
  CAL1.4:: 1-6
- **Derivative function**
  Read §2.3
  §2.3: 2-5, 9, 10
  Read §2.4 (product rule)
  CAL 1.4: 7-9, 12
  CAL 1.4: 10, 11, 13-15 (for fun)
- **Chain rule**
  Read §2.5
  §2.5: 1,2, 7,8,9,17-20
  CAL 1.4: 16, 17, 18
- **The quotient rule**
  Read §2.4 (quotient rule)
  §2.4: 11-18, 24-25
  §2.5: 21, 22, 24-26, 28, 34, 37, 38
  CAL 1.4: 19-22
- **Trigonometric functions**
  Read §2.4 (trigonometric functions)

§2.4: 7-10,19-22
§2.5: 12, 13, 14, 23, 29, 32, 33, 36, 39, 40, 41, 42
CAL 1.4: 23, 24

Foundation of differential calculus

- **Fermat/Rolle/Mean-Value theorem**
  Read §4.1,§4.2
  CAL1.5: 1,6
  CAL1.5: 2-5 (for fun)
- **Monotonicity and min/max**
  Read §4.3
  §4.3: 1-6, 11, 12 (no concavity)
  CAL1.5: 8-11
- **Concavity**
  Read §4.3
  §4.3: 25-31, 45
  CAL1.5: 12
  CAL1.5: 13, 14 (for fun)

Exponential and Logarithms

- **Exponential limits**
  Read §3.1
  Read lecture notes
  §3.1: 24-30
  CAL1.6: 1,2
- **Exponential derivatives**
  Read §3.3 (2nd part)
  §3.3: 19-24, 28, 30
  CAL1.6: 3-6
  CAL1.6: 7-9 (for fun)
- **Inverse functions**
  Read §3.2 (inverse functions)
  §3.2: 21,22,24,27 (no graphing calculators)
  CAL1.6: 10
  §3.2: 31-40
  CAL1.6: 11,12
- **The Natural Logarithm**
  Read §3.2 (logarithm)
  Read §3.3 (derivatives of logarithmic functions)
  §3.2: 23,25,26,69, 63-68
  CAL1.6: 13,14,15
  §3.2: 71-76
  CAL1.6: 22
  §3.3: 2-7, 9-18, 29, 33, 34, 42, 43, 47, 48
  CAL1.6: 16, 18,19
  CAL1.6: 17,20,21 (for fun)
- **General Exponential function**
  Read lecture notes
  §3.3: 25, 26, 40, 55-60
  CAL1.6: 23,25,24
  CAL1.6: 26,27 (for fun)
- **General logarithm**
  §3.2: 43-46, 72
  CAL1.6: 28, 29,31
  CAL1.6: 30,32

Other Inverse functions

- **Inverse trigonometric functions**
  Read §3.5
  §3.5: 1, 2a, 3, 4, 5, 7, 8-10
  CAL1.7: 1,2
  §3.5: 16, 17, 19-22, 24-29
  CAL1.7: 3, 4
  §3.5: 35-38
  CAL1.7: 5
- **Hyperbolic functions**
  Read §3.6
  §3.6: 1-4, 5b, 6, 9-15
  CAL1.7: 6,7
  §3.6: 19,20,22
  CAL1.7: 7-10
  CAL1.7: 11 (for fun)
- **De L'Hospital rule**
  Read §3.7
  §3.7: 1-38
  §3.7: 41, 42, 45 (for fun)
  CAL1.7: 13,12
  CAL1.7: 14,15 (for fun)

Introduction to integrals

- **Definition of the Riemann integral**
  Read §5.1, §5.2
  §5.2: 15-18, 25, 26, 53
  CAL1.8: 1,2,3
- **Fundamental theorem of calculus I**
  Read §5.4
  §5.4: 5-14, 24,28
  CAL1.8: 4,5,8
  CAL1.8: 6,7 (for fun)
- **Fundamental theorem of calculus II**
  Read §5.3
  §5.3: 4-15, 17, 28-30
  CAL1.8: 9,10
- **Method of substitution**

Read §5.5
§5.5: 37-40, 43-52, 11, 13-20, 22, 24, 31, 32

CAL1.8: 11, 12,14
CAL1.8: 13 (for fun)