The University of Texas – Rio Grande Valley
Syllabus for MATH 2346.01R/31R: Math for EE and CE Summer II 2025
EMAGC 1.320 MTWRF 15:00–16:30
BINAB 2.204 MTWRF 15:00-16:30

Contact information

Instructor: Dr. Eleftherios Gkioulekas, School of Mathematical and Statistical Sciences
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Office location: EMAGC 3.214

Course information

Prerequisites: CSCI 1380 (or CSCI 1387) or CMPE 1170/1370 (or CMPE 1378/1178) with a grade of 'C' or better, and MATH 2413 (or MATH 2487) with a grade of 'C' or better.
Corequisites: None.
Course Description: This course covers the essentials of matrix theory, graph theory, numerical methods, and introduction to proofs needed for majors in Electrical and Computer Engineering. Topics include Gauss-Jordan elimination, matrix algebra, determinants, graphs, trees, root finding algorithms, numerical differentiation, numerical integration, numerical matrix methods, propositional and predicate logic, and formal logic proofs.
Course modality: The course lectures will be live-streamed synchronously at the scheduled days and times. Some of the live streams will be conducted from the classroom, however due to the reduced sitting format, 50% to 85% of the lectures will be fully online. Attendance will be tracked via weekly submission of homework on the Discussion Forums. Exams will be given in take-home format and will be distributed and collected via Brightspace, and returned via email.

Textbook

(1) E. Gkioulekas (2009): "Lecture Notes on Mathematics for Electrical Engineers", *Online Lecture Notes on Mathematics*, University of Texas Pan American, 302 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

Other References

(1) D.A. Santos (2006): "Linear Algebra", Community College of Philadelphia, 237 pp.
- Open Educational Resource
- This document can be downloaded as a pdf file, at no cost, from https://faculty.utrgv.edu/eleftherios.gkioulekas/OGS/Santos/santos-linearalgebra.pdf

(2) W. Keith Nicholson (2019): "Linear Algebra with Applications", Open Edition, Lyryx Learning, 698 pp.
- Open Educational Resource
- This document can be downloaded as a pdf file, at no cost, from https://lyryx.com/linear-algebra-applications/

(3) J. Aldous and R.J. Wilson (2003): "Graphs and Applications: An Introductory Approach", pringer, 444 pp. (ISBN-10: 185233259X)
- Commercial Textbook
- Available new for $49 from http://books.google.com/books?id=1qRvTI_oWUAC

(4) Bondy and Murty (2008): "Graph Theory with Applications", Graduate Texts in Mathematics (Book 244), Springer, 663 pp. (ISBN-10: 1846289696)
- Commercial Textbook
- Available new for $50 from http://www.amazon.com/Graph-Theory-Graduate-Texts-Mathematics/dp/1846289696

(5) N.A. Pereyra (2018): "Logic for Physicists", IOP Publishing, 58 pp. (ISBN-10: 1643270133)
- Commercial Textbook

- Available new for $11 from
  https://www.amazon.com/dp/1643270133/

Outline of Topics

- **Brief introduction to logic and sets**
  Logic, sets, and quantified statements
  Set definitions
  Cartesian product
- **Linear Algebra**
  Matrices
  Basic operations with matrices
  Matrix multiplication
  Matrix inverses
  Matrix transpose
  Exam 1
- **Determinants and Linear Systems**
  Determinants
  Cofactor expansion of determinants
  Simplification of determinants
  Matrix inverse
  Linear systems of equations: Cramer's rule
  Linear systems of equations: Gaussian elimination
- **Graph theory. Part I**
  Graphs – Basic terminology
  Types of graphs
  Graph operations
  Connected graphs
  Graph connectivity
  Eulerian graphs
  Hamiltonian graphs
  Exam 2
- **Eigenvalues and eigenvectors**
  Definitions
  How to find the eigenvalues
  How to find the eigenvectors
  Characteristic polynomial
  Cayley-Hamilton theorem
- **Graph theory. Part II**
  Adjacency matrix
  Trees
  Minimum spanning tree problem (Kruskal's algorithm)
  Exam 3
  Planar graphs
  Shortest path problem

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, similarly to the presentation shown in the solution sets and similarly to the examples covered in the lecture notes and in class.

In short, I expect you to ***learn what I am teaching you in class***, and to rely on the examples included in the lecture notes and the examples covered in class to ***learn how to write precise and rigorous mathematical arguments***.

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.
- **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 and will be collected via Brightspace discussion forums on a weekly basis. 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.

Attendance Policy

- **Attendance Policy:** Due to the asynchronous online modality of the course, attendance will be assessed with your participation in the discussion forums where you are expected to upload and discuss your solutions to the weekly homework assignments. The instructor has the prerogative to drop any student with four (4) or more unexcused absences, with each absence corresponding to failing to submit a homework assignment. The submitted homework should reflect a sincere effort to solve as many of the assigned homework problems as possible. **If you miss any major exam, you will be dropped from the course.**
- **Lecture Recordings:** The use of recordings will enable you to have access to class lectures, group discussions, etc. in the event you have to miss a synchronous or face to face class meeting due to illness or other extenuating circumstance. Our use of such technology is governed by the Federal Educational Rights and Privacy Act (FERPA), UTRGV's acceptable-use policy, and UTRGV HOP Policy STU 02-100 Student Conduct and Discipline. A recording of class sessions will be kept and stored by UTRGV, in accordance with FERPA and UTRGV policies. Your instructor will not share the recordings of your class activities outside of course participants, which include your fellow students, teaching assistants, or

graduate assistants, and any guest faculty or community-based learning partners with whom we may engage during a class session. You may not share recordings outside of this course. Doing so may result in disciplinary action under UTRGV HOP Policy STU 02-100 Student Conduct and Discipline.

Other Policies

- **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.
- **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.

Technical Requirements

- **Computer Hardware:** To participate in this course, you should have easy access to a computer less than 5-years old with high-speed internet connection via cable modem, LAN or DSL. It is strongly recommended that you also have a printer (to print lecture notes) and scanner (to scan homework and take-home exams).
- **Student Technical Skills:** You are expected to be proficient with installing and using basic computer applications and have the ability to send and receive email attachments.
- **Software:**
  - Mozilla's Firefox or Google Chrome
  - Adobe Acrobat
  - Zoom
  - Media player software (e.g. Quicktime, Windows Media Player, etc.)
  - Virus protection Software
  - Microsoft Word or TeXLive

Document Scanning

- Take home exams and homework assignments should be submitted as ONE PDF file per submission. Name your file: **Lastname-Firstname.pdf** using your First and Last name.
- **DO NOT JUST TAKE PHOTOGRAPHS OF YOUR PAPERS WITH A PHONE!!!!! DON'T SEND ME IMAGE FILES!!! I need a PDF document that can be printed, and just taking pictures will not work.**
- **WRITE WITH A DARK PEN. DO NOT USE A PENCIL, ESPECIALLY A LIGHT ONE.** Your document may be barely readable on screen but not print well.
- **I won't be able to grade an exam that looks unreadable on paper.**
- To scan with a printer/scanner, please use the following settings:
  - 400 dpi (less than 300dpi will not look good)
  - Black and White
  - Scan as PDF file

  The printer/scanner will then create a pdf file.
- To scan with a phone **YOU MUST USE A SCANNING APP**. For both Android phones and iphones, I recommend using Mobile Doc Scan. To use the app, you take a photograph of the paper and then adjust the bounding box to the four corners of your paper. Image processing algorithms then produce an image

that looks as if you fed the document through a real scanner. You need to do this for each page, so this is less convenient than an actual scanner. The app can be used to generate a PDF file, which you can then transfer to a computer and submit by email.

Student Learning Outcomes

After completing this course students will be able to

(1) Perform the basic operations of matrix algebra.
(2) Solve a system of linear equations using Gauss-Jordan elimination, including augmented matrices and elementary row operations.
(3) Compute matrix inverses when they exist and solve linear systems using matrix inverses where applicable.
(4) Compute determinants of square matrices using the definition, elementary row operations, and cofactor expansion, know the basic properties of determinants, and solve linear systems using Cramer's rule where applicable.
(5) Compute eigenvalues and eigenvectors of a square matrix and apply them to problems in engineering, mathematics, and science.
(6) Know graph terminology, graph connectivity, Euler and Hamilton paths, planar graphs, and some of the major problems of graph theory, such as shortest path problems (solved by Dijkstra's algorithm).
(7) Understand trees, traversals of trees, sorting, and minimal spanning trees (Kruskal's algorithm).
(8) Apply formal methods of symbolic propositional and predicate logic.
(9) Know how to use formal logic proofs and logical reasoning to solve problems.
(10) Understand various proof techniques and determine which type of proof is best for a given problem.