

## Course Information

Course Number:	MATH 689
Course Title:	Special Topic: A Transition to Graduate Level Mathematics
Section:	700
Location:	<i>This is an asynchronous online class.</i>
Time:	<i>All references to times in this course are in the Central Time zone.</i>
Credit Hours:	3

## Instructor Details

Instructor:	Oksana Shatalov
E-Mail:	shatalov AT math.tamu.edu
Office Hours:	Monday 5 pm – 6 pm (Central Time) and by appointment ( <i>on Zoom</i> ).

## Graders Details

Ozan Acikgoz <oa806 AT tamu.edu>

## Course Description

MATH 689. A Transition to Graduate Level Mathematics. (3-0). Credit 3. Important concepts and techniques in Linear Algebra, Real Analysis, and Differential Equations with an emphasis on problem-solving and proofs. Prerequisites: MATH 171, MATH 172, MATH 221, and MATH 323 or equivalent; or approval of instructor.

## Course Learning Outcomes

This is a transitional course that is specifically designed to bridge the gap between an undergraduate degree in math, or a bachelor's degree in some other field, and graduate-level classes. It contains what is needed to enter the mathematics MS program well-prepared. It focuses on important concepts and techniques in Linear Algebra, Real Analysis, and Differential Equations. The topics covered will be treated in more depth than is typical in undergraduate courses, with an emphasis on problem-solving and proofs.

Upon completion of this course, students will be able to see the main concepts and methods they learned previously from a more rigorous and/or general point of view and learn to apply them to a wider range of applications. At the end of the course, the students will

- have an understanding of the definitions and terms of Advanced Linear Algebra and Real Analysis;
- have confidence and skills in operating with matrices and their determinants;
- understand the ideas of vector spaces, subspaces, linear dependence, bases, dimensions, inner product spaces, orthogonality, and the Gram-Schmidt process;
- learn to find the null space, range, and matrix of a linear transformation;

- understand the structure of linear transformations and their use;
- learn the notions of normal, self-adjoint, and unitary operators and their properties;
- learn the eigenvectors and eigenspaces technique;
- be able to find the canonical form of a quadratic form and apply quadratic forms to classify the critical points of functions;
- understand limits and their use in sequences, series, differentiation, and integration;
- be able to use curvilinear coordinate systems in the plane and space;
- be able to apply the concept of change of order of integration and change of variables to evaluate multiple integrals and their usage in computing the area and volume;
- be able to compute line and surface integrals and use Green's theorem to evaluate line integrals and areas;
- be able to apply Stokes' and the Divergence Theorem to evaluate multiple integrals;
- be able to use tools from linear algebra to study systems of linear differential equations;
- be able to analyze the qualitative behavior of solutions to nonlinear differential equations, e.g., the stability properties of equilibria.

### Textbook and/or Resource Materials

1. Henry Ricardo, *A Modern Introduction to Linear Algebra*, New York: Chapman and Hall/CRC, 2009, [eBook ISBN 9780429184413] (available online through TAMU library)
2. Brian S. Thomson, Judith B. Bruckner, Andrew M. Bruckner, *Elementary Real Analysis*, Prentice-Hall, 2001, xv 735 pp. [ISBN 0-13-019075-61]
3. Barbara D. MacCluer, Paul S. Bourdon, and Thomas L. Kriete, *Differential Equations: Techniques, Theory, and Applications*, American Mathematical Society, 2019, 890pp [PRINT ISBN 9781470447977, EBOOK ISBN 9781470454388] (available online through TAMU library)

### Course Format, Technical Requirements, and Support

This course is a 15-week asynchronous online course. Throughout the course, [Canvas](#) will be used as the primary venue for lectures, discussions, assignments, and collaboration with classmates. You will need to participate in discussions and submit all assignments and projects via [Canvas](#) (the learning management system supported by TAMU). Thus, you must be familiar with it. In addition to accessing [Canvas](#) through <https://canvas.tamu.edu/>, you can find a link to it in the [Howdy](#) portal. To access the system, you will use your TAMU netid and password. Please contact me immediately if you are unable to access the course website. If you require more technical assistance, try Help Desk Central (<http://hdc.tamu.edu/> or 979-845-8300). Help Desk Central is open 24 hours each day, 7 days a week, 365 days a year.

### Time Frame

For this class, the “online week” will reset **at noon on Wednesdays**. This means that one week of assignments will end on Wednesday at noon and a new week of assignments will begin. Your final grades will be posted in [Howdy](#) at the end of the course, but your individual grades on assignments will be viewable in [Canvas](#) regularly. Students are expected to follow the course outline and engage and participate in the activities outlined in each weekly lesson. Students are required to keep pace with the

class, follow the course outline, and complete necessary reading, video lectures, and assignments by the posted due dates. **Due dates are expressed in day and hour CT (Central Time).** Students are responsible for adjusting due dates to their time zone.

### Communication Strategy

Here are several ways you can communicate with your classmates and me.

- **Class Announcements:** Class announcements will be posted in [Canvas](#) and sent to your university e-mail account (Make sure to check your notification preferences to control how the course updates are sent.) In addition, some announcements will be made through a video recording called *“A Weekly Message from Your Instructor”* (posted typically at the beginning of each online week). You are responsible for watching *“A Weekly Message from Your Instructor”* and checking your account and the course page to be familiar with the announcements.
- **Email:** Email is the best way to contact me on an individual basis. Please use the Inbox tool in Canvas to write to me about Math 689. Other correspondence can be directed to [shatalov@math.tamu.edu](mailto:shatalov@math.tamu.edu). I will do my best to respond to you within 24 hours of your email. I hope that I can respond quicker than 24 hours, but I can’t guarantee a quick response all the time, especially on the weekends.
- **Zoom Appointment:** I am available for video conferences using ZOOM. Make sure you email me your availability when scheduling an appointment.
- **Discussion Forum:** Each week on [Canvas](#) a discussion forum will be available. Use this forum to ask your classmates questions about work in the class or to clear up any confusion regarding class instructions, procedures, materials, or assignments.

### Grading Policy

*At the end of the semester, you will be given your grade based on the scale provided. I am unable to discuss grades via email or phone due to FERPA privacy concerns. Please schedule a Zoom meeting with me if you have a question about your grade.*

### Grade Breakdown

ACTIVITY	%	POLICIES, DUE DATES, AND REMARKS
Homework	60	Typically, it will be assigned weekly on <b>Wednesday at noon</b> (12 assignments in total) and it will be due next Wednesday at noon. It must be turned in on time. More details are below.
Midterm Exam	20	Friday, <b>October 14</b> at 6 pm (Central Time). You will probably need to join the session before the official exam start time. (e.g., for ID checks).
Final Exam	20	Friday, <b>December 9</b> at 6 pm (Central Time). You will probably need to join the session before the official exam start time.

Participation	Participation in discussions (see below) and other activities may also count up to <b>three extra points</b> added to the final grade. Participation will only be used to help a student's grade, and it will be determined by the judgment of the instructor. If class participation is insufficient, the final grade will be calculated without.
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### Grading Scale

Range	Grade
$90 \leq \text{Average} \leq 100$	<b>A</b>
$80 \leq \text{Average} < 90$	<b>B</b>
$70 \leq \text{Average} < 80$	<b>C</b>
$60 \leq \text{Average} < 70$	<b>D</b>
Average < 60	<b>F</b>

- **Homework:** Individual assignments will be assigned each week throughout the course, with each student submitting their solutions to a given problem set. You must show all of your work and justify your answers in order to receive full credit for the homework. You may email me, discuss with classmates via the discussion board, or look things up on the web or in a book while working on individual assignments, but you may not copy answers. Copying a solution from a source and referencing the source is still considered a violation of academic integrity because you are submitting work for a grade that is not your own work. You must cite the source if you use resources to complete your assignments. For more information on plagiarism and the Aggie Code of Honor, see the section on Academic Integrity below. Here is a *tentative* list of due dates:

Hmwk	1	2	3	4	5	6	7	8	9	10	11	12
Due Date	Aug 31	Sep 7	Sep 14	Sep 21	Sep 28	Oct 5	Oct 19	Oct 26	Nov 2	Nov 9	Nov 16	Nov 30

***It should be noted that homework assignments will be weighted differently.***

- **Exams:**
- *Your exam solutions must be your own work, using only resources I explicitly allow, consistent with the university rules on academic integrity.*
  - The exams will be proctored through Zoom, using a 2-device set-up. During each exam, you will be required to set up a streaming video camera (cell phone or USB webcam) in such a way that the proctor will be able to view you, your workspace, and your computer screen during the exam. You will need your computer/laptop to complete the exams. The proctoring sessions might be recorded for University purposes. ***In order to receive credit for this course, you are required to consent to be proctored in this manner.***
  - You will work the exams on your own paper and then scan and submit your work. The duration of each exam will be about 2-2.5 hours. Additional instructions will be announced before each exam.

- **Participation in Discussions:** Regular interaction online is strongly encouraged, and a portion of it is figured into your overall grade. Learning what other classmates know about mathematics and how they think about mathematics is a very valuable aspect of the learning process. It is good practice to log onto [Canvas](#) 4 to 5 times a week to check in and participate in discussions. A discussion board will be available for each weekly assignment and these discussion boards should be used as a platform for collaboration on assignments. There is also an option to subscribe to discussions, so you receive notifications of new posts and replies.

### Late Work Policy

Late work will NOT be accepted unless you have a university-approved reason and contact me (not graders) within two business days of the missed assignment.

### Makeup Policy

- If you must miss an exam due to illness or other university excused absence, notify me or the Statistics Department (before, if feasible, otherwise within two working days after you return). Contact me as soon as possible to schedule a make-up exam.
- An Incomplete Grade will be given only in the event you have completed most of the course but circumstances beyond your control cause prolonged absence from class and the work cannot be made up.

### Appeal Policy

Students have 3 business days to notify the instructor of any inaccuracies in their graded work upon the return of individual grades. Students should bring all grade disputes to their instructor in an individual Zoom meeting. Due to FERPA privacy issues, grade disputes will not be discussed over email.

### Tentative Course Schedule

Week	Topic
1	Vector Spaces. Subspaces. Determinants. Span and Linear Independence of vectors.
2	Basis and Dimension. Rank and Nullity of a Matrix. Basis and Coordinates. Change of Basis. Linear Transformations.
3	Range and Kernel. Linear Equations. Matrix Transformations. Matrix of a Linear Transformation, Similar Matrices.
4	Geometry of Linear Transformations. Eigenvalues and Eigenvectors of a Matrix. Characteristic Polynomial. Eigenvalues and Eigenvectors of and Operator. Eigenspaces.
5	Basis of Eigenvectors. Diagonalization. Complex Eigenvectors and Eigenvalues. Euclidean Structure in $\mathbb{R}^n$ . Norms and Inner Product.
6	Orthogonal Complement. Orthogonal Projection. Orthogonality in Inner Product Spaces. The Gram-Schmidt Process. Adjoint Operator and Adjoint Matrix.
7	Normal Operators and Normal Matrices. Diagonalization of Normal Operators. Quadratic Forms.
8	Functions and Graphs. Topology of the real line: Open and Closed Sets. Limits of Functions.

	<b>Midterm Exam.</b>
9	Continuity. Properties of Continuous Functions. Monotonic Functions. Exponential Functions. Derivative. Differentiability Theorems.
10	Mean Value Theorem. Differential and Linearization. Taylor's Formula. Limit of a sequence. Monotonic Sequences. Limit points.
11	Riemann Integral. Riemann Sums, Properties of the Integral. Fundamental Theorem of Calculus. Indefinite Integral. Area and Volume. Multiple Integrals. Infinite Series. Tests for Convergence.
12	Gradient, Divergence, and Curl. Line Integrals. Green's Theorem. Conservative Vector Fields. Surface Area. Surface Integrals. Gauss' Theorem. Stokes' Theorem.
13-14	Ordinary Differential Equations (separable, exact, first order linear, second order linear with constant coefficients). Applications.
15	<b>Final Exam</b>

## University Policies

### Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](#) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

### Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to [Student Rule 7](#) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" ([Student Rule 7, Section 7.4.1](#)).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" ([Student Rule 7, Section 7.4.2](#)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](#).)

## Academic Integrity Statement and Policy

“An Aggie does not lie, cheat or steal, or tolerate those who do.”

“Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one’s work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case” ([Section 20.1.2.3, Student Rule 20](#)).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at [aggiehonor.tamu.edu](http://aggiehonor.tamu.edu).

## Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below). Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit [disability.tamu.edu](http://disability.tamu.edu).

## Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see [University Rule 08.01.01.M1](#)):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is

handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

*Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with [Counseling and Psychological Services \(CAPS\)](#).*

*Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's [Title IX webpage](#).*

### **Statement on Mental Health and Wellness**

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care by utilizing available resources and services on your campus

*Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at [suicidepreventionlifeline.org](https://suicidepreventionlifeline.org).*