Course Information

Course Number:	MATH 645
Course Title:	A Survey of Mathematical Problems I
Section:	699 & 700
Location:	*This is an asynchronous online class.*
Time:	*All references to times in this course are in the Central Time zone.*
Credit Hours:	3

Instructor Details

Instructor:	Oksana Shatalov
Office:	Blocker 360C
Phone:	(1) 979 845 3623
Mail:	Please use the Inbox tool in Canvas to write to me about Math 645. Other correspondence can be directed to shatalov@math.tamu.edu
Office Hours:	**Friday 3:30 p.m. - 4:30 p.m.** (Central Time) and by appointment on Zoom. *(See also the Communication Strategy section.)*

Graders Details

Ozan Acikgoz <oa806@tamu.edu>

Course Description

Catalog Description: A survey of problems in various branches of mathematics, such as logic, probability, graph theory, number theory, algebra, and geometry.

This course is a core part of the Distance Masters Program targeted at current and prospective teachers of mathematics at the secondary school level or higher. Our aim in the course is not to impart any specific body of knowledge but to foster the student's understanding of what mathematics is all about. The goals are:

- To increase students' mathematical knowledge and skills.
- To expose students to the breadth of mathematics and many of its interesting problems and applications.
- To encourage students to have fun with mathematics.
- To increase students' competence with open-ended questions, with questions whose answers are not known, and with ill-posed questions.
- To teach students how to read and understand mathematics.
- To give students confidence that they will either know an answer or know where to look for an answer when their students ask them questions.

Course Prerequisites

MATH 409, MATH 415, and MATH 423, or approval of the instructor.

Textbook and Resource Materials

1. *Survey of Mathematical Problems (Student Guide)* by Harold Boaz and Sue Geller, Texas A&M University (2006) (https://www.math.tamu.edu/~geller/math645/studentguide06.pdf)
2. *Numbers, Groups & Codes* by J. F. Humphreys, and M. Y. Prest, Cambridge University Press (2004), ISBN 9780521540506
   (https://ebookcentral.proquest.com/lib/tamucs/detail.action?docID=259848)
3. *Cryptography: Theory and Practice* by Douglas Robert Stinson and Maura Peterson, (Fourth Edition, 2018), CRC Press LLC, ISBN 9781138197015
   (https://ebookcentral.proquest.com/lib/tamucs/detail.action?docID=5493336)
4. *Book of Proof* by Richard Hammack (Third Edition, 2018), Published by Richard Hammack
   (https://www.people.vcu.edu/~rhammack/BookOfProof/Main.pdf)
5. *The Fascinating World of Graph Theory* by Arthur Benjamin, Gary Chartrand, Ping Zhang, Princeton University Press (2015), ISBN 0691163812
   (https://ebookcentral.proquest.com/lib/tamucs/detail.action?docID=1791868)
6. *Other reading materials will be posted on* Canvas *throughout the semester.*

Course Learning Outcomes

We hope that after completing this course, students will have an expanded perspective on the mathematical endeavor and a renewed enthusiasm for mathematics that they can convey to their students in the future.

At the end of the course, the students will
- be able to construct valid logical arguments and solve logical problems.
- be able to identify and construct valid proofs by the method of mathematical induction.
- understand the notions of axiomatic systems, consistency, and independence.
- understand the notions of the Eulerian graph, Hamiltonian graph, planar graph, and dual graph.
- learn about Euler's formula, its proof, and its consequences.
- become familiar with some famous problems of mathematics, such as the traveling salesman problem, the Konigsberg bridge problem, and the four-color problem.
- Learn about Dirac's theorem, its proof, and its applications.
- Learn about Kuratowsky's Theorem and how to apply it.
- appreciate the breadth of easily stated unsolved problems that exist in number theory.
- learn about Euler's ϕ function, and Euler's generalization of Fermat's Little Theorem.
- learn about and know how to use the Chinese Remainder Theorem to solve systems of equations.
- learn some cryptography, especially what RSA codes are and how to use them.

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, it is necessary for you to 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

The first day of the online course is January 17, 2023. For this class, the "online week" will reset <u>at noon on Tuesdays</u>. This means that one week of assignments will end on Tuesday 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 grades on assignments will be viewable in Canvas regularly. Students are expected to 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

Since the class is asynchronous and most students are working individuals in different time zones, it is difficult to find a time that would work for all students. Here are several ways you can communicate with your classmates and me.
- **Office Hours:** on Zoom (Friday 3:30-4:30 (CT) and by appointment.)
- **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.) It is your responsibility to check your account and the course page and get 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 645. Other correspondence can be directed to 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

 You will receive the grade you earned at the end of the semester, according to the scale given. Due to FERPA privacy issues, I cannot discuss grades over email or phone. If you have a question about your grade, please schedule a one-on-one Zoom meeting with me.

✓ **Grading Scale**

Range	Grade
$90 \leq$ Average ≤ 100	A
$80 \leq$ Average < 90	B
$70 \leq$ Average < 80	C
$60 \leq$ Average < 70	D
Average < 60	F

✓ **Grade Breakdown**

ACTIVITY	%	POLICIES, DUE DATES, AND REMARKS
Homework	**70**	It will be assigned weekly every **Tuesday at noon** and it will be due next Tuesday at noon. More details are below.
Writing Project	**30**	The paper will be an expository paper on a mathematical topic and will be at least 3000 words, not including diagrams and references. The list of topics will be provided by the instructor at the beginning of the semester and the topic selection will be on a first come/first served basis. The term paper will be due **Friday, May 5**. More details are below.
Participation		Participation in weekly non-graded discussions may also be worth up to three additional points added to the final grade. Participation will only be used to improve a student's grade, and it will be determined at the instructor's discretion. If there is insufficient class participation, the final grade will be calculated without it.

➢ Homework: Each week throughout the course there will be individual assignments whereby each student will turn in their own solutions to a given problem set. For full credit on the homework, you must show all work and justify your answers. Note that some assignments may require using the discussion board during the week. When working on the individual assignments, you may email me, discuss with classmates via the discussion board, or look things up on the web or in a book, but you may not copy answers. You must write up your solutions in your own words, notation, and/or symbols; 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. If you use resources to complete your assignments, you must cite the source. For more information on plagiarism and the Aggie Code of Honor, see the section on Academic Integrity below. Homework assignments are due on the following Tuesdays by noon (CST):

Homework	1	2	3	4	5	6	7	8	9	10	11
Due Date	Jan 24	Jan 31	Feb 7	Feb 14	Feb 21	Feb 28	Mar 7	Apr 4	Apr 11	Apr 18	Apr 25

You may choose one of two ways to **turn in your assignments**:

❖ Type your solutions to the assignment in an electronic format of your choosing (Latex, Word, etc.), convert to a PDF, and then submit the PDF.
❖ Write your assignment on paper and then scan the paper(s) as a merged PDF document. Then submit the merged PDF document.

After submitting each assignment, be sure you check the submitted document to make sure the format in which you are turning in your assignment is readable (i.e., the resolution is good, the scan quality is clear, etc.). If it is not easily readable, your assignment **will not be accepted**. It is the responsibility of the student to turn in work that is readable by the grader.

Note that your homework assignments will be graded by the math department's graduate student most of the time. If you have questions about the grading of the homework assignments, you can either contact the graders directly or contact me.

Note that, in general, we are not going to be posting solutions. Since this is a graduate class, it is hard to create new problems for such types and so we don't want solution keys floating around on the Internet. We will try to give as much feedback as possible on graded assignments to show where a solution might have gone wrong. If even after the feedback, you do have any more questions about how to solve a particular problem, feel free to add them to the discussion board or email the grader and/or instructor.

➢ Writing Project: **Pay attention to the following due dates** as they may be different from the due dates for weekly assignments.

Writing Project Stage	%	Due Date	Comments
Topic Selection		Friday, January 20	Instructions and a list of topics will be provided on the Canvas course page.
Paper Proposal	8	Tuesday, January 24	
Paper Outline	8	Monday, March 20	
Term Paper Draft		Thursday, March 23	The draft must meet the main term paper requirements and should be as close to your final paper idea as possible. It does not, however, need to be a polished presentation of the topic. If a student submits a poorly written draft, they may lose up to 10 % of the total term paper grade.
Editorial Work	16	Tuesday, March 28	To do editorial work, a student must submit the draft.
Final Term Paper	68	Friday, May 5	

➢ **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.

Netiquette: Be sure to participate responsibly and respectfully which is consistent with good academic practice. Violation of netiquette will result in your withdrawal from the class.

Course Schedule

Week	Topic
1	Communicating Mathematics. **Writing Project** [Topic Selection and Paper Proposal]
2 & 3	Logical Reasoning.
4	Axiomatic Systems. Principle of Mathematical Induction.
5	Integers and Diophantine Equations. Continued Fractions.
6	Modular Arithmetic. Groups Z_m and U_m. Chinese Reminder Theorem.
7	Fermat's Little Theorem, Euler's φ function, and Euler's generalization of Fermat's Little Theorem. Cryptography. RSA Code.
8 & 9	**Writing Project** [Paper Outline, Draft, Peer Editing]
10	Introducing Graphs. Traversing Graphs.
11	Hamiltonian Graphs. Dirac's Theorem. Gray Codes.
12	Regular Graphs, Classes of Regular Graphs. Isomorphic Graphs. Planar Graphs. Kuratowsky's Theorem.
13	Coloring Graphs. Chromatic Numbers. Relationship Graphs.
14 & 15	**Writing Project** [Final Stage]

Late Work Policy

Late work will NOT be accepted unless you have a university-approved reason (as defined by TAMU Student Rule 7) and contact me (not the grader) within two business days of the missed assignment.

Makeup Policy
- Makeup work will only be allowed in cases of a university excused absence in accordance with TAMU Student Rule 7.
- If you cannot submit a homework assignment or must miss an exam due to illness or other university excused absence, notify me (before, if feasible, otherwise within two working days after you return). Contact me as soon as possible to schedule a make-up.

- 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.

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.

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.

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.