TEXAS A&M UNIVERSITY

SYLLABUS

Course Title: ***MATH 666 – Seminar in Geometry***
Term: Summer 2020 (5 weeks)
Meeting times and location: This is an online class. All references to times in this course are in the Central Time Zone.
Instructor Information:

- **Name:** Igor Zelenko
- **Email address:** zelenko@math.tamu.edu
- **Office hours:** by appointment (via ZOOM)

Course Description and Prerequisites: This is an introductory graduate level course in Differential Geometry.
In the first part of the course on the simplest examples of curves and surfaces in 3D we will examine several fundamental concepts such as moving frames, curvatures, covariant derivatives, parallel transport, geodesics and etc. In the second part of the course we will make a quick introduction to manifolds, tensors, differential forms, and elements of Riemannian Geometry.

***Prerequisites*:** undergraduate Linear Algebra and Multivariable Calculus or approval of instructor.
Learning outcomes: You will be familiar with the basic language and constructions in Differential Geometry and will be able to use this language in understanding of topics in Theoretical Physics (e.g., General Relativity) and of applications in Engineering (the analysis of stress and strain in materials, Continuum Mechanics, Control Theory) and Computer Science (Computer Vision).
Textbooks:

1. Manfredo P. Do Carmo, *Differential Geometry of Curves and Surfaces*: Revised and updated Second Edition (Dover Books on Mathematics), the book is available electronically through the Evans library webportal
2. Iskander A. Taimanov, *Lectures on Differential Geometry*, EMS Series of Lectures in Mathematics, 2008
3. (optional, will be replaced by my own lecture notes) Manfredo P. Do Carmo, *Differential Forms and Applications, Springer (Universitext).*
4. *(recommended as the main reference to Vector Calculus, but will be replaced by my own lecture notes)* Jerrold E. Marsden , Anthony Tromba, *Vector Calculus, Sixth Edition, 2012.*

Other reading materials will be posted on eCampus throughout the semester.
Course Format, Technical Requirements and Support This course is a 5-week asynchronous online course. Throughout the course, eCampus will be used as the primary venue for lectures, discussions, assignments, quizzes, and collaboration with classmates. You will need to participate in discussions and submit all assignments and projects via eCampus . Thus, it is necessary for you to be familiar with eCampus (the learning management system supported by TAMU). Please visit http://ecampus.tamu.edu/student-help for helpful student tutorials. In addition to accessing eCampus through http://ecampus.tamu.edu/ you can find a link to eCampus 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 Tuesday, June 30, 2020 and the last day is Wednesday, August 3, 2020. For the purposes of this class, the "online week" will reset *at 10am on*

Tuesdays. This means that one week of assignments will end on Tuesday at 10am 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 eCampus on a regular basis. 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 class, follow the course outline, and complete necessary reading and assignments by the posted due dates. Due dates are expressed in day and hour CST (Central Standard Time). Students are responsible for adjusting due dates to their time zone.

Communication Strategy: There are several ways you can communicate with your fellow classmates and myself.

- *Email:* Email is the best way to contact me on an individual basis. I am easily accessible via zelenko@math.tamu.edu . I will do my best to respond to you within 24 hours of you email. I hope that I can respond quicker than 24 hours, but I can't guarantee a quick response all of the time, especially on the weekends. When emailing please BE SURE to put *Math 666* in the subject line.
- *Video Appointment:* I am available for video conferences using ZOOM (you can find a link to it in the Howdy portal.).
- *"Hello classmates, I need help!" Discussion Forum:* In eCampus there is a discussion forum titled "Hello classmates, I need help!". 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.

  Netiquette: Be sure to participate in a responsible and respectful way that is consistent with good academic practice. To learn about polite online behavior, or "netiquette", check the following link: http://albion.com/netiquette/corerules.html. Violation of netiquette will result in your withdrawal form the class.

Guidelines for Online Class Participation 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 in the learning process. It is good practice to log onto eCampus 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.

Grading Policy Your final grade will be determined by your performance on the homework and two exams. The grade ingredients are:

Activity	%
Exam 1 and Exam 2	35%
Homework	60%
Participation	5%
Total:	100%

- **Grading Scale**

Range	Grade
90 -100 %	A
80- 89 %	B
70-79 %	C
60-69 %	D
0-59 %	F

Weekly Assignments Each week throughout the course there will be individual assignments whereby each student will turn in their own solutions to a give problem set. When working on the individual assignments, you may email me, discuss with classmates via the discussion board (Hello classmates, I need help!), 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 Aggie Code of Honor, see the section on Academic Integrity below. Weekly assignments are due on Tuesdays by 10am (CST).

***Turning in Homework*:** When turning in your assignments please follow the guidelines below:

1. On each assignment you turn in, the submitted document must have your name, the due date of the assignment, and the assignment number.
2. Save the file as LastName_Assignment#_Math666.
3. You may choose one of two ways to turn-in your assignments:

   (1) 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 via eCampus.

   (2) Write your assignment on paper and then scan the paper(s) as a merged PDF document. Then submit the merged PDF document via eCampus.
4. 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. resolution is good, 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 most of the time your assignments will be graded by the math department's graduate student. If you have questions on the grading of the assignments, please let me know and I'll help you or I will get you in contact with the grader.

WEEK	**TOPIC** (BELOW BY DC X.X WE DENOTE THE CORRESPONDING SECTION X.X IN DOCARMO'S BOOK # 1 IN THE LIST, BY T X.X THE CORRESPONDING SECTION X.X FROM TAIMANOV'S BOOK, BY LN MY OWN LECTURE NOTES, BY DC3 X THE CORRESPONDING CHAPTER OF DOCARMO'S BOOK #3 IN THE LIST, BY MT X.X THE CORRESPONDING SECTION FROM MARSDET & TROMBA BOOK).
1	A) Basic notions of theory of curves: regular curves, tangent lines, arc length, parametriztion by arc length (DC 1.2-1,3, T 1.1) .Curvature of the curve, Frenet frame in R^2 (T 1.2); Frenet frame in R^3, torsion (DC 1.5) Frenet Frame in R^n (brief sketch of the construction); B) Regular surfaces: implicit function theorem, inverse function theorem , regular and critical values, definiton of regular surface (DC 2.2,; T 1.4, T 2.1;MT 3.5,); Differential functions on surfaces (DC 2.3); The tangent plane; the differential of the map (DC 2.4);
2	The first fundamental form ; Area (DC 2.5, end of T 2.1), Orientation on surfaces (DC 2.6). Gauss map (DC 3.2); Second fundamental form, principal curvature, Gaussian and mean curvatures (DC 3.2 continued, T 2.2-2.3);
3	The Gauss map in local coordinates (DC 3.3); Isometries (DC 4.2); Gauss Egregium theorem, equations of compatibility (Gauss, Peterson-Mainardi-Codazzi), fundamental theorem of theory of surfaces (Bonnet theorem) (DC 4.3, T 2.1-2.5); **EXAM 1**
4	Covariant derivative, parallel transport; geodesics (DC 4.4, T 2.6). The Euler-Lagrange equation and geodesics as shortest paths (T 2.7); Gauss-Bonet theorem (DC 4.6, T 2.8) and its application such as Poincare index theorem (DC 4.6); Introduction to differential forms (LN, DC3 Chapter 1, MT 8.5)
5	The differential form approach to intrinsic geometry of surfaces (LN, DC3 5.3) Introduction to

	smooth manifolds (T 3.1-3.2); Tensors (T 3.3-3.4), Metric tensor (T 4.1); Affine connection and covariant derivative, Chtistoffel symbols, torsion tensor; Levi-Civita Connection (T 4.3), Riemann curvature tensor (T 4.4)
AUG 5	**EXAM 2**

Attendance Policy: This is an asynchronous online course, so attendance will not be figured into your grade. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Late Work Policy: No late work is accepted for unexcused absences per Section 7.4 of the University Student Rules Policy.

Make-up Policy: Students may be excused from turning in an assignment for the reasons stated in Section 7.1 (http://student-rules.tamu.edu/rule7.htm) or other reason deemed appropriate by me (the instructor). To be excused you (the student) must notify me in writing (acknowledged e-mail message is acceptable) prior to the date of absence if such notification is feasible. In cases where advance notification is not feasible (e.g. accident, or emergency) the student must provide notification by the end of the second working day after the absence. This notification should include an explanation of why notice could not be sent prior to the class. For approved excuses for missed assignments, an appropriate modified due date will be set by me (the instructor).

Americans with Disabilities Act (ADA) Policy Statement:

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

Academic Integrity Statement: AGGIE HONOR CODE "*An Aggie does not lie, cheat, or steal or tolerate those who do*". Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the TAMU community from the requirements or the processes of the Honor System. For additional information please visit: http://aggiehonor.tamu.edu/.

Scholastic Dishonesty: Copying work done by others, either in class or out of class, looking on other students papers during exams or quizzes, having possession of unapproved information in your calculator, and/or having someone else do your work for you are all acts of scholastic dishonesty. These acts, and other acts that can be classified as scholastic dishonesty, will be prosecuted to the full extent allowed by University policy. Punishment can range from a zero on the assignment/quiz/exam to expulsion from the university. In any case of scholastic dishonesty, the student forfeits their right to Q-drop the class. In this class, collaboration on assignments, either in class or out of class, is forbidden unless permission to do so is granted by the instructor.

Copyright Policy: All printed materials disseminated in class or on the web are protected by Copyright laws. One copy (or download from the web) is allowed for personal use. Multiple copies or sale of any of these materials is strictly prohibited.

Title IX and Statement on Limits to Confidentiality: Texas A&M University and the College of Science are committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws provide guidance for achieving such an environment. Although class materials are generally considered confidential pursuant to student record policies and laws, University employees — including instructors — cannot maintain confidentiality when it conflicts with their responsibility to report certain issues that jeopardize

the health and safety of our community. As the instructor, I must report (per Texas A&M System Regulation 08.01.01) the following information to other University offices if you share it with me, even if you do not want the disclosed information to be shared:

• Allegations of sexual assault, sexual discrimination, or sexual harassment when they involve TAMU students, faculty, or staff, or third parties visiting campus.

• These reports may trigger contact from a campus official who will want to talk with you about the incident that you have shared. In many cases, it will be your decision whether or not you wish to speak with that individual. If you would like to talk about these events in a more confidential setting, you are encouraged to make an appointment with the Student Counseling Service (https://scs.tamu.edu/).

• Students and faculty can report non-emergency behavior that causes them to be concerned at http://tellsomebody.tamu.edu .