

Course Information

Course Number: MATH 623

Course Title: Differential Geometry II

Section: 500

Time:

MWF 01:35 pm-02:25 pm

Location: ONLINE, ZOOM,

The links to the course zoom meeting can be find in the Zoom links section in the eCampus

Credit Hours: 3

Instructor Details

Instructor: **Igor Zelenko**

Office: 601J

Phone: 979-820-0620

E-Mail: zelenko@math.tamu.edu

Office Hours: **Tuesday-Friday, 11:00-12:30 pm** via Zoom.

Textbook and/or Resource Materials

Main Text:

Liviu Nicolaescu, *Lectures on Geometry of Manifolds*, 2nd Edition, World Scientific Publishing, 2007 (the 1st edition can be used as well)

Other texts (optional, all required materials will be provided):

1. **Michael Spivak**, *A Comprehensive Introduction to Differential Geometry: Volume II* (mainly as a reference for the topic of connections on vectors and principle bundles, Chapters 6-8 there)
2. **Manfredo Perdigao do Carmo (Author)** (Francis Flaherty (Translator)), *Riemannian Geometry*, 1st Edition, Burkhauser Boston, 1992 (mainly for homework assignments and as a reference for Variational theory of geodesics and comparison theorems, mainly chapters 5, 9, 10 and also some of chapter 6 there)
3. **R.W. Sharpe**, *Differential Geometry:Cartan's Generalization of Klein's Erlangen Program*, Springer Graduate Texts in Mathematics, Vol. 166 (mainly as a reference for Cartan method of equivalence in application to extrinsic geometry of submanifolds of homogeneous spaces, Chapter 3 there)

4. **S. Sternberg**, *Lectures on Differential Geometry*, AMS Chelsey Publishing, 2nd Edition (mainly as a reference to the theory of connections on principal bundles and G-structures, chapter VII there)

The material that not included on the texts above will be posted in the form of the lecture notes.

Additional references that you may like to consult include:

5. **S. Kobayashi, K. Nomizu**, *Foundations of Differential Geometry*, Vol 1 (1963) and 2 (1969), Interscience publisher.

6. **S. Gallot, D. Hulin, J. Lafontaine**, *Riemannian Geometry*, **any edition (there are 3 editions)** (especially regarding algebraic decomposition of Riemannian curvature tensor coming from the representation theory and Weyl conformal tensor, also a great source for various comparison theorems)

Course Prerequisites

Some basic concepts from Linear algebra, Topology, and Analysis on manifolds.

The course Differential Geometry I, M622, is strongly recommended but not required. The undergraduate prerequisites are standard Calculus courses (MATH 171/151, 172/152, 221/251 or equivalent), Differential Equations (MATH 308), and Linear algebra (MATH 304 or 323). I will give all mathematical background beyond the above courses in the class.

Course Description

This is the second semester of a year-long graduate course in differential geometry. We will discuss the theory connections on vector bundles :covariant derivatives, connection forms, parallel transport,curvature tensor, torsion , Bianchi identities (Nicolaescu , subsection 3.3), elements of Riemannian Geometry :Levi-Civita connection, geodesics, properties of Riemannian curvature tensor, Weyl conformal tensor (using Gallot-Hullin-Lafonrtaone); elements of Cartan's method of moving frames and Geometry of submanifolds of Riemannian manifolds, the Gauss-Bonnet theorem for oriented surfaces (Chapter 4 of Nicolaescu), The variational theory of Geodesics: Jacobi fields, conjugate points, Bonnet-Myers and Rauch comparison theorems (Section 5,2 of Nicolaescu and Chapters 9 and 10 of DoCarmo), Elements of Cohomology theory: De Rham cohomology, the Poincare duality and elements of intersection theory (Nicolaescu, subsections 7.1, 7.2, and 7.3), Characteristic classes: Connection in principle bunde, G-structures , Invariant polynomials, , the Chern-Weil theory, Chern classes, Pontryagin classes, Euler class, Gauss-Bonnet-Chern theorem (Nicolaescu, Chapter 8, for connections in principle bundles and elements of G-structures the additional sources are Chapter 8 of Spivak and Chapter VII of Sternberg). If the time will permit we will discuss prolongation of G-structures, Cartan connection with

applications to Conformal and Projective Geometry (the corresponding sources and materials will be provided).

Course Learning Outcomes

You will be able to conduct research involving various geometric objects such as moving frames , curvature tensors etc in various directions (geometric, analytic, topological, and algebraic)

Grading Policy

Your final grade will be determined by your performance on the homework and the final presentation. The grade ingredients are:

• Activity	• %
• Bi-weekly Homework Assignments	• 70%: It will be usually posted on Wednesdays with due date in 2 weeks
• Final presentation	• 30%: In the beginning of November it will be assigned to you in advanced on a topic which continues some topic discussed in a class or on a new topic which was not covered in class. The rresentation will be via Zoom in the final exam period , I.e Dec 1-Dec 9. The schedule will be determined later.
• Total:	• 100%

Grading Scale

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

Grade complaints:

If you think a homework was graded incorrectly you have one week from the time the graded assignment was returned to you to bring the issue to the instructor's attention. No complaints after that time will be considered.

Exams: There will not be exams in this class.

Late Work Policy

Late work will NOT be accepted unless you have a University approved reason and contact me within two working days of the missed assignment.

Zoom Etiquette

- **When joining class remotely via ZOOM**, please join with your audio off. When you have a question during class you may (1) use the "CHAT to everyone" feature to type your question, (2) use the "raise your hand" feature and wait for me to call on you, or (3) unmute yourself, politely interrupt me, and I will pause and give you time to ask your question. It is important to me that the students joining remotely are involved in the class discussion, but it is best if we do this in an organized way.
- **OFFICE HOUR ATTENDEES** When joining office hours via ZOOM, please join with your audio off. Everyone attending office hours will be joining one room, so if you would like to ask a question during office hours, please "raise your hand" and wait to be called on. If you need to speak to me privately, and have not made an individual appointment with me, please let me know through a private CHAT message and I will move you to a breakout room where we can talk one-on-one.

University policies

Attendance policies

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.

NOTE: Faculty associated with the main campus in College Station should use this Academic Integrity Statement and Policy. Faculty not on the main campus should use the appropriate language and location at their site.

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 Disability Resources in the Student Services Building or at (979) 845-1637 or visit 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.

NOTE: Faculty associated with the main campus in College Station should use this Americans with Disabilities Act Policy statement. Faculty not on the main campus should use the appropriate language and location at their site.

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, you 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](#).

NOTE: Faculty associated with the main campus in College Station should use this Title IX and Statement on Limits of Liability. Faculty not on the main campus should use the appropriate language and location at their site.

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 proper self-care by utilizing the resources and services available from Counseling & Psychological Services (CAPS). Students who need someone to talk to can 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.

COVID-19 Temporary Amendment to Minimum Syllabus Requirements

The Faculty Senate temporarily added the following statements to the minimum syllabus requirements in Fall 2020 as part of the university’s COVID-19 response.

Campus Safety Measures

To promote public safety and protect students, faculty, and staff during the coronavirus pandemic, Texas A&M University has adopted policies and practices for the Fall 2020 academic term to limit virus transmission. Students must observe the following practices while participating in face-to-face courses and course-related activities (office hours, help sessions, transitioning to and between classes, study spaces, academic services, etc.):

- Self-monitoring—Students should follow CDC recommendations for self-monitoring. **Students who have a fever or exhibit symptoms of COVID-19 should participate in class remotely and should not participate in face-to-face instruction.**
- Face Coverings—[Face coverings](#) (cloth face covering, surgical mask, etc.) must be properly worn in all non-private spaces including classrooms, teaching laboratories, common spaces such as lobbies and hallways, public study spaces, libraries, academic resource and support offices, and outdoor spaces where 6 feet of physical distancing is difficult to reliably maintain. Description of face coverings and additional guidance are provided in the [Face Covering policy](#) and [Frequently Asked Questions \(FAQ\)](#) available on the [Provost website](#).
- Physical Distancing—Physical distancing must be maintained between students, instructors, and others in course and course-related activities.
- Classroom Ingress/Egress—Students must follow marked pathways for entering and exiting classrooms and other teaching spaces. Leave classrooms promptly after course activities have concluded. Do not congregate in hallways and maintain 6-foot physical distancing when waiting to enter classrooms and other instructional spaces.
- To attend a face-to-face class, students must wear a face covering (or a face shield if they have an exemption letter). If a student refuses to wear a face covering, the instructor should ask the student to leave and join the class remotely. If the student does not leave the class, the faculty member should report that student to the [Student Conduct office](#) for sanctions. Additionally, the faculty member may choose to teach that day's class remotely for all students.

Personal Illness and Quarantine

Students required to quarantine must participate in courses and course-related activities remotely and **must not attend face-to-face course activities**. Students should notify their instructors of the quarantine requirement. Students under quarantine are expected to participate in courses and complete graded work unless they have symptoms that are too severe to participate in course activities.

Students experiencing personal injury or illness that is too severe for the student to attend class qualify for an excused absence (See [Student Rule 7, Section 7.2.2.](#)) To receive an excused absence, students must comply with the documentation and notification guidelines outlined in Student Rule 7. While Student Rule 7, Section 7.3.2.1, indicates a medical confirmation note from the student's medical provider is preferred, **for Fall 2020 only, students may use the Explanatory Statement for Absence from Class form in lieu of a medical confirmation. Students must submit the Explanatory Statement for Absence from Class within two business days after the last date of absence.**

Operational Details for Fall 2020 Courses

For additional information, please review the [FAQ](#) on Fall 2020 courses at Texas A&M University.

College and Department Policies

College and departmental units may establish their own policies and minimum syllabus requirements. As long as these policies and requirements do not contradict the university level requirements, colleges and departments can add them in this section.
