Math 545: Differential Geometry

Instructor: Guy David

Fall 2026 Syllabus

Class Information: MWF, 12:00 - 12:50 pm, in Robert Bell 106.
All additional class information, assignments, etc. will be posted on the **Canvas website**.
Instructor Information: Guy David, gcdavid@bsu.edu.
I will generally respond to emails within 24 hours Monday-Friday.
Office: Robert Bell 421. Office phone: (765) 285-8640
Office hours will be held multiple times each week. See Canvas for information.
Prerequisites: C- or better in MATH 217 and 267 or permission of the department chairperson.
Required textbook and materials: *Elementary Differential Geometry*, Revised Second Edition, by Barrett O'Neill. You will also need access to a scanner or smartphone scanner app to make pdfs.

Official course description, objectives, and rationale

Course Description: Fundamentals of differential geometry, as an extensive study of curves and surfaces in 3-space. The course includes the use of computer visualization and emphasizes the importance of differential geometry in areas like relativity theory and modern physics.
Course Objectives: MATH 545 introduces students to the fundamentals of classical differential geometry. Students are expected to develop an intuitive understanding of geometry and a series of advanced computational skills. Students will be able to

- Apply advanced computational skills, e.g., involving vector fields, differential forms, and covariant differentiation, in the context of differential geometry of curves and surfaces.
- Compute various types of curvatures of curves and surfaces and explain their geometric meanings.
- Recall, exhibit, and apply theorems concerning the differential geometry of curves and surfaces.

Course Rationale: Differential geometry is a basic tool for understanding the large-scale structure of the universe. This course is of interest to science students who wish to see how ideas from first- and second-year calculus are elaborated into one of the triumphs of modern physics.

Coursework

Reading

You will be expected to read the appropriate sections of the textbook as well as other readings posted online. **Reading mathematics is not like reading most prose.** It is an active experience involving pencil and paper: you should be checking to see if you understand each sentence, flipping back to recall earlier definitions and theorems, coming up with examples, trying to prove statements or do computations yourself, etc.

Homework

There will be **weekly homework sets** in the course. These will be posted on Canvas each **Friday** and will usually be due **by 12:00 pm** (class time) on the following **Friday**. They will consist of problems from the textbook as well as some assigned by me. You should explain your solutions to these problems **clearly and in full detail**. Write in **complete sentences** where appropriate. You should **never turn in the first draft of your homework**: take a second draft to organize your arguments clearly.

All students should **scan and upload pdfs of your homework to Canvas**. Instructions are on Canvas. Do not directly upload smartphone photos. Please let me know if you think this will be difficult for you.

Late homework will generally not be accepted. However, the lowest homework score will be dropped from your final grade. If you are having difficulties meeting deadlines, talk to me and we will try to work something out.

When you sign your name to your homework, you are attesting that it is your own work. You are welcome (encouraged!) to work with your classmates. You are welcome (encouraged!) to talk to me for (substantial!) assistance on the problems. However, **when you write up your answers, you should do it on your own in language that you understand**. Copying text from a classmate, online resource, or AI system (even if "slightly modified") is not acceptable. To avoid the pitfalls of outsourcing your own thinking, I ask that you do not use generative AI systems at all to help with your homework. I reserve the right to ask you for an in-person chat about things that you have written in your homework.

Homework assignments will generally have some selected problems graded carefully for correctness and some for completion. **You should always talk to me about problems you don't understand.**

Exams

There will be **two 50-minute midterm exams and one 2-hour final exam**. All of these exams will be **in person**. The midterm exams are tentatively scheduled for **Oct. 2** and **Nov. 15** in class, with the final exam on **December 9 from 12:00-2:00 pm**. Generally, only exceptional circumstances (documented illness, family emergency) call for rescheduling an exam. Talk to me if you have an issue.

Presentation

MATH 545 students will give presentations to the class (in groups of 1 or 2) on Monday December 7. More information will be provided in class and on Canvas.

Communication

All information about the course will be posted on our **Canvas website**. I'm happy to discuss mathematics or anything related to the course by email or during my office hours. **If you would like to talk live during a time outside of my usual office hours, then send me an email and we will set up a time to chat.**

Grading

Your final course grade will be computed as: 5% Presentation, 15% Homework, 25% Exam 1, 25% Exam 2, 30% Final Exam.

At the end of the course, I will use the above scheme to assign you a numerical grade, which will be converted into a letter grade by a table like the following:

A	A-	B+	B	B-	C+	C	D	F
≥ 93	90-93	87-90	83-87	80-83	77-80	70-77	60-70	<60

I may adjust these cutoffs downwards (i.e., to be more lenient) at the end of the semester, depending on the overall difficulty of the assignments and exams.

There is no form of "extra credit" in the course beyond the assignments and exams explained in this syllabus. **The best way to get a good grade in the course is to attend class, do all assigned readings and problems, and ask questions during class and office hours.**

Attendance

Students are expected to attend class. **If you do miss class, it is your responsibility** to learn the material we discussed on your own. You can do this by reviewing the textbook sections, and of course I am happy to help in office hours.

Class time should be for **active learning**, not passive watching. Please arrive on time and participate in class discussions: ask questions and propose ideas. Please do not use your phone, laptop, etc. during class time, unless instructed otherwise.

Other policies and resources

We will abide by the Student Academic Ethics Policy. This includes a commitment to **not representing the work of others as your own.** Copying solutions from a classmate, book, AI system, or website is a violation of these policies.

I may modify this syllabus and the course calendar during the semester.

Withdrawals

The course withdrawal period ends on **October 28, 2026**. Before this date, students can elect to receive a "W" for the course by completing and submitting the proper form. The instructor's permission is not required. For details, see Degree Requirements and Time Limits in the current Undergraduate Catalog.

University Statement

We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse.

Disability Statement

If you need course adaptations or accommodations because of a disability, please contact the instructor of record as soon as possible. Ball State's Disability Services Office coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability Services can be contacted at 765-285-5293 or dsd@bsu.edu.

Freedom of Expression

In this course, we are committed to fostering a learning environment that values intellectual diversity, encourages free expression, and promotes open inquiry. As members of the Ball State Community, we treat each person in the Ball State community with civility, courtesy, compassion, and dignity and respect and learn from differences in people, ideas, and opinions. Please review Ball State University's Statement on Freedom of Expression, the resources on Ball State's Freedom of Expression webpage, and Ball State's Beneficence Pledge.