Math 497-Fall 2021

Topics in Mathematics: Mathematical Geodesy

General information

Class location: Duncker 109
Class time: MWF 4-4:50pm
Professor: Greg Knese
Office hours: Tu 9:30-10:20am, W 4:50-5:40, Th 10:30-11:20am
Email: geknese at wustl dot edu

Course description

Mathematical geodesy is the science and art of measuring and mapping our world. This course will develop the mathematics related to maps, mapping, and the production of geospatial data. Topics may include: popular conformal map projections, the complex plane and conformal mapping including a brief introduction to complex analysis, spherical trigonometry, the geometry of the ellipsoid of revolution, three-dimensional coordinates and transformations, orbital motion of satellites, and the surface theory of Gauss. This course will focus on the mathematical or geometric side of geodesy and not the physical aspects involving potential theory.

Prerequisites: Math 233, Math 308/318 preferred. Math 309 is also very helpful.

Course Format

The course will be in-person MWF 4-4:50pm in Duncker 109. Attendance is strongly encouraged but not mandatory. Classes will be recorded and posted on canvas in case you cannot attend due to illness/suspected illness/possible exposure. All course materials will be available on canvas.

Office hours on Tuesday and Thursday will be conducted via zoom. Wednesday office hours are right after class and will be held in our classroom or outside.

Grades and Homework

There will be weekly or bi-weekly homework. Grades will be composed entirely of homework scores.

Textbook and other References

Map of the World: An Introduction to Mathematical Geodesy by Martin Vermeer and Antti Rasila. CRC Press. 2020

Geodesy: Introduction to Geodetic Datum and Geodetic Systems by Zhiping Lu, Yunying Qu, and Shubo Qiao. Springer 2014. Available at link.springer.com on the campus network.

Geometric Reference Systems in Geodesy by Christopher Jekeli. 2016. Available at https://kb.osu.edu/handle/1811/77986

Course plan

Mapping of the sphere
— Coordinates on the sphere
— Tangent planes, angles, areas
— Conformal linear transformations
— orthogonal transformations and geodesics
— Spherical trigonometry
Mapping of ellipsoids
— geometry of the ellipsoid of revolution
— popular conformal map projections
Complex analysis and conformal maps
— Basics of the complex plane
— Analytic functions
— Conformal mappings
—Transversal Mercator projections
Coordinate reference systems
Orbital motion of satellites
Surface theory of Gauss
Riemann surfaces
Map projections in light of surface theory

Health Related information

If you become sick during the semester please let me know as soon as possible so we can make accommodations.