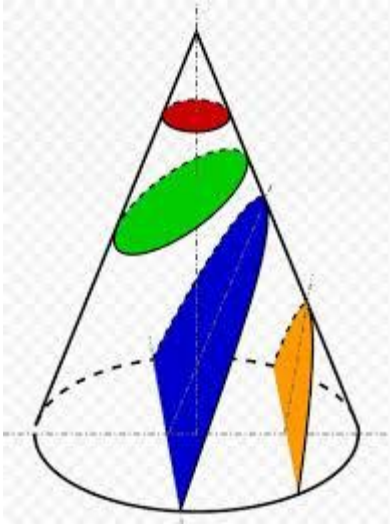
MME 518 Geometry

Summer 2022



Overview: this course intends to cover many areas of *analytic* geometry in a mix of classical and modern approaches. Additionally it seeks to investigate the transition from 2 to 3 dimensional geometry in as reasonable a manner as possible. Further it seeks to provide a foundation for any geometry your students will encounter in college level Calculus and other courses. To achieve quality 3 dimensional geometry, contemporary software is explored. Finally, applications of geometry are developed thru project work primarily.

This is a 3 credit course. The standard model for a 3 credit course is 14 weeks with 3 hours of class time per week. We will instead have 2 hours per week of class time with that 3rd hour being replaced by project work on your part.

Put perhaps more simply, at any given time, you have classwork and associated homework going on, and in parallel, project work outside of class. There is some choice involved on projects with the Radius of the Earth project being fixed for everyone.

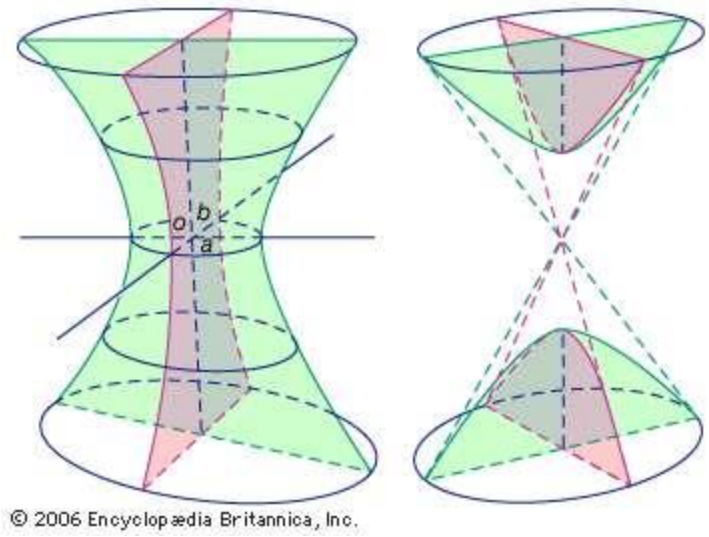
Textbook The course material is very much my own development and there is no textbook that matches up with it. Hence class notes and lectures are important. However I do need you to have a book for reference. So my best hope is that you have or can come up with

Calculus Early Transcendentals 7th edition Edwards and Penney Pearson

Which a number of you have from other MME courses. This is a very standard calculus text that goes from differential thru multivariable Calculus with many background areas included. If you wish to buy one, don't pay much as it is long out of print. $10-15 is plenty. If you have some equivalent book, go with that. They are all mostly the same, unfortunately.

Schedule So as to come up with 14 meetings, yet finish by July 1, we have to double up in June, with meetings on Tuesdays *and* Thursdays. (unless someone comes up with a better scheme). The same goes for MME 531.

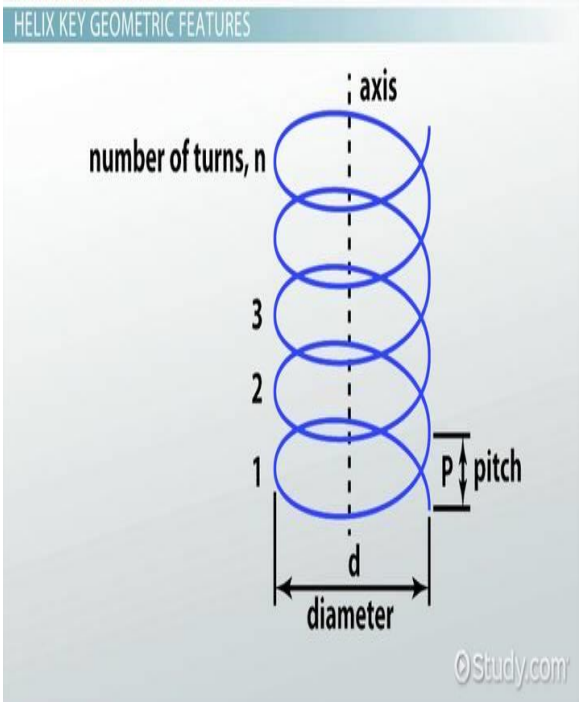
Topics



1) **Vectors and supporting topics**
   Pythag Thm Law of Cosine
   Addition et al geometrically
   Dot products
   Cross products
      area, volume
   Planes
   Trig Identities: do your own.
2) **Parametric Curves via vectors**
   R^2 and R^3
   circular motion; helices
   Great Circles
3) **Conic Sections**
   Two dimensional definitions and derivations
      Reflection Properties
      Asymptotes and hyperbolas

   Rotations to achieve standard form. What is y = 1/x geometrically?

   Three dimension connect as cross sections of cones
   Polar Coordinates
      polar equations; polar curves
   Area under Bell Curve



4) **Three Dimensional Surfaces**

   volumes of revolution

   Quadric Surfaces

   General cones

      and pyramids

5) **Parametric Surfaces**
   concept; strategies
   surface area
      flux thru a surface
   Torus surface area
   Cartesian function approach

6) **Fractals**
   concept
      self similarity; recursion; repeatability
   dimension
   applications
7) **Conformal Mappings**
   geometry of complex numbers
   Julia Sets revisited

Weekly

One homework assignment, posted sometime Wednesday, due a week later. This continues thru June (meaning even though 2 classes, only 1 assignment)

One exam, so no homework that week.

Projects (3)

* indicates required

Radius of the Earth* Using the simple geometry of the ancient Greeks, replicate Eratosthenes estimation of the radius of the Earth. You will need a partner at a different location. You will need to pay attention to the calendar. Beyond that, you're on your own. A prize is offered for the best paper. Due by July 1

Active vs Passive Solar Panels
Explore the geometry and benefits of actively following the sun vs fixed (roof) panels. A byproduct of MME 528

Geometry in your curriculum*
What geometry, of any kind, do students who eventually graduate from your curriculum *actually* learn? What do they show up at college with? This likely differs a bit from what is stated in your formal curricula.

Your response should show topics and courses, as well as varying by track (Honors, College Prep . . .) and should not only be based on documents but informal discussions with teachers.

Response such as "we'd like to do such-and-such but we need time for MCAS" are part of some people's reality.

Fractal Dimension

Generate actual data from either the coast of Maine or a head of broccoli or find data on the human lung.

Geogebra Tutorial

Develop a self contained tutorial so that a student or teacher could read it and come away with the ability to do reasonable 2 and 3 dimensional plots. Should be electronic and include actual worksheets you developed.

Specific applications: dynamic parabola and ellipse.

Spherical Geometry

What's life like on a sphere, geometrically? What's an equilateral triangle like? What's the shortest distance between 2 points? What's a Great Circle?