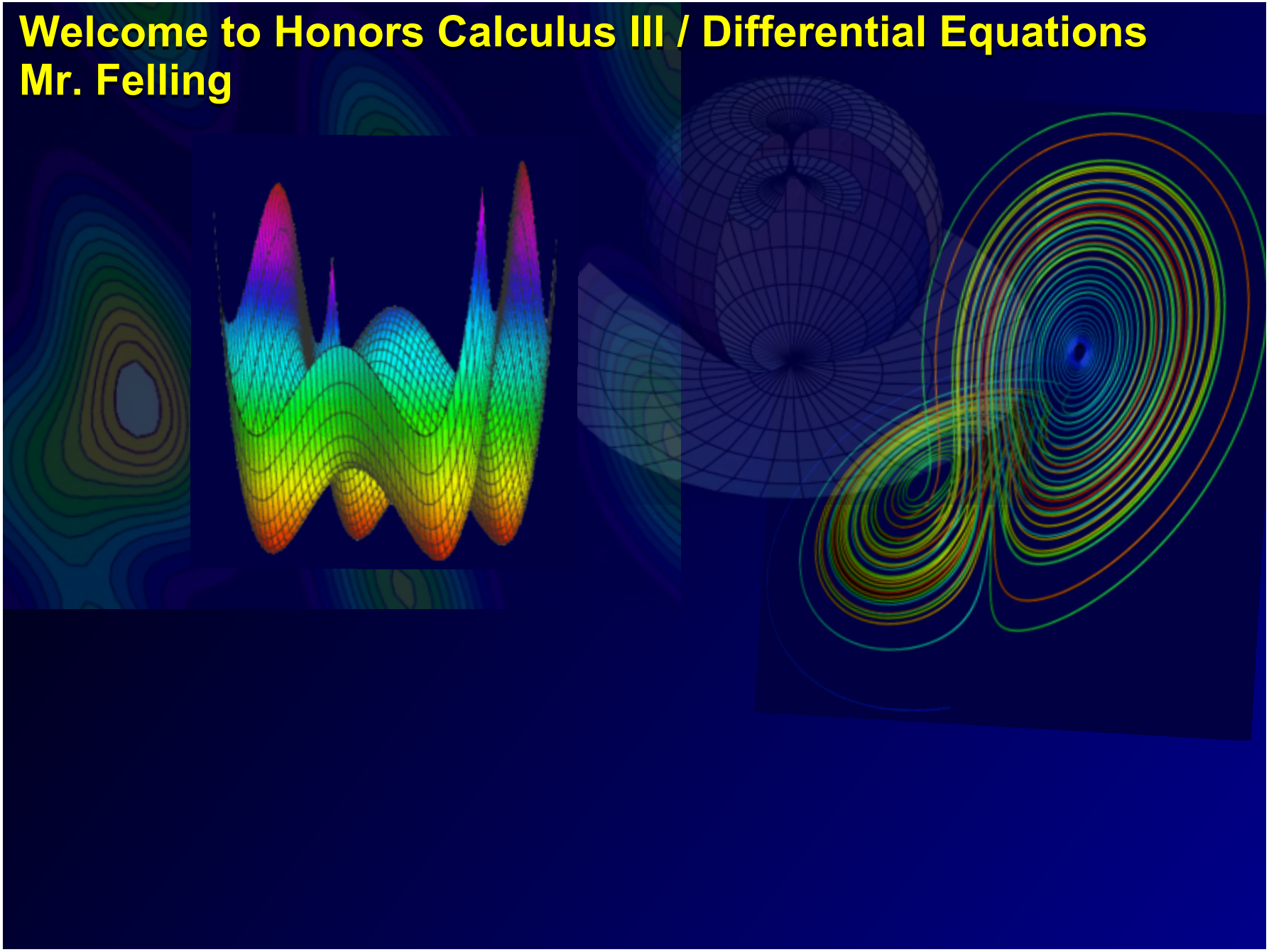
Welcome to Honors Calculus III / Differential Equations
Mr. Felling



Evacuation route

What is Calculus III?

- Calculus III is the 3rd semester in the sequence Calculus w/Analytic Geometry I, II, III required by many STEM majors in college. (I and II are AP Calculus BC)

- It considers what we can do with calculus concepts in more than 2 dimensions (primarily 3D, but we'll occasionally consider higher dimensions).

- It is the math that much of physics and engineering requires for study...the foundation for things like electromagnetism and gravity.

- It is needed in other fields whenever you are working with functions with more than one input and more than one output (economics, business, social sciences).

- Can take 1st semester for college credit through Rio Salado MAT241 (4 credits) if you have college credit for AP Calculus BC.

What are Differential Equations?

- 'Differential Equations' are equations which contain a derivative.

- In AP Calculus BC we learned the 'separation of variables' technique for solving - This course teaches many more solving techniques.

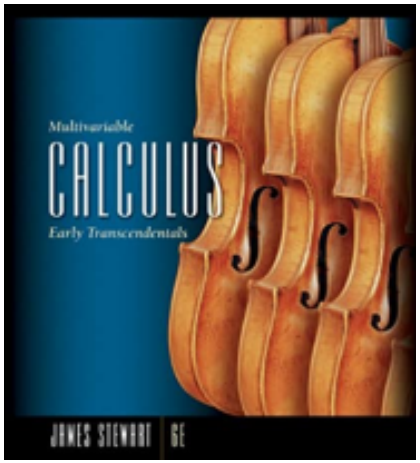
- Differential Equations are very useful for modeling the world in any situation where things change (which is basically everything!) We will study some of the more interesting applications.

- Differential equations is an active area of math research - solving more complex differential equations is among the most difficult math, but this course focuses on procedures to solve the most basic and useful equations.

- This is usually the class engineers and mathematicians take right after Calculus III.

- Can take 2nd semester for college credit through Rio Salado MAT277 (3 credits) if you have college credit for AP Calculus BC.

Calculus III topics/structure

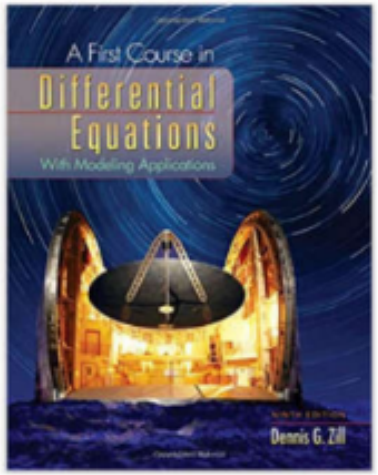


The course is based on the Stewart Calculus book, Ch12-16.

- **Ch12: Vectors and the geometry of space**
  (vectors, dot/cross product, equations of lines and planes in 3D, nonlinear (quadric) surfaces in 3D) no calculus yet
- **Ch13: Vector functions**
  (derivatives/integrals of vector functions, arc length/curvature, projectile motion)
- **Ch14: Multivariable Functions / Partial Derivatives**
  (multivariable functions/limits, partial derivatives, tangent planes, chain rule, directional derivatives/gradient, optimization including Lagrange multipliers)
- **Ch15: Multiple integrals**
  (double integrals (rectangular/polar), triple integrals (rectangular/cylindrical/spherical), applications of multiple integrals)
- **Ch16: Vector Calculus**
  (vector fields, line integrals, potential functions, Green's Theorem, curl/divergence, parametric surfaces, surface integrals, Stokes' Theorem, Divergence Theorem)

Some chapters will be broken into two parts with separate tests.

Differential Equations topics/structure



The course if based on 'A First Course in Differential Equations' by Dennis Zill

- **Ch1: Differential Equation terminology and definitions**
  (terminology, initial value problems)
- **Ch2: First-Order Differential Equations**
  (slope fields, autonomous DEs, separable DEs, linear DEs, substitutions)
- **Ch3: Modeling with First-Order Differential Equations**
  (linear and non-linear models)
- **Ch4: Higher-Order Differential Equations**
  (homogeneous and non-homogeneous DEs, Wronskian, reduction of order, constant/ undefined coefficients, annihilator method, Cauchy-Euler DEs)
- **Ch5: Modeling with Higher-Order Differential Equations**
  (linear models)
- **Ch7: The Laplace Transform**
  (Laplace/Inverse Laplace transforms and role in solving DEs, translations, derivative of a transform, Dirac delta function)
- **Ch8: Systems of Linear First-Order Differential Equations**
  (homogeneous/nonhomogeneous DEs, eigenvalues/eigenvectors)
- **Solving DEs numerically using Octave (MatLab) software**

Less intense than AP Calculus BC

- Although some parts of this course are conceptually complicated, there are fewer topics than in AP Calculus BC, so we can afford to take more time to learn/absorb things.

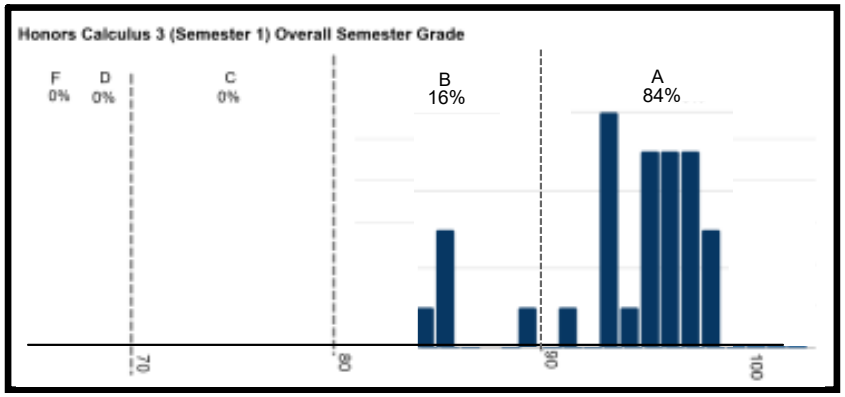
- We don't have to prepare for an AP Exam, so we don't have to deal with rigid formatting requirements, and we don't have to leave time at the end of the year to prepare for an AP Exam.

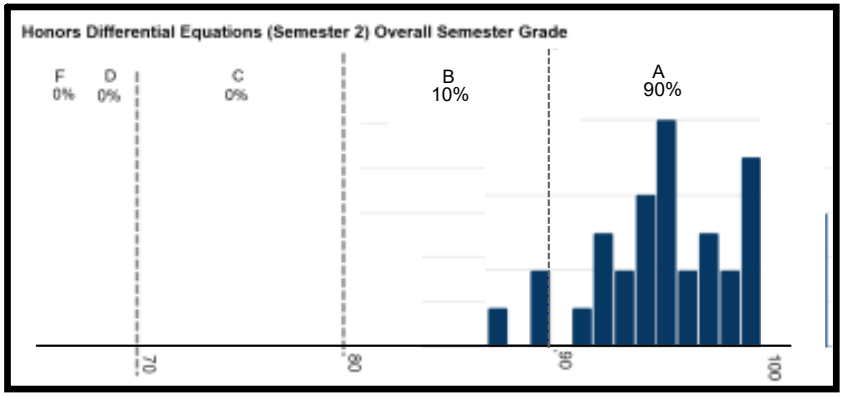
- The topics in this course are also very interesting!

My first career was Electrical Engineering and in college I chose to specialize in Electromagnetics and Communication Systems, primarily because I really enjoyed the math in Calculus III!

Students typically do very well in this course...

Typical semester grades in this course:





Materials to bring to class

Calculator

- Although we don't need a calculator as much in this class as AP Calc BC or AP Statistics, there are still times when we will need a calculator.
- It is a requirement for this course that you bring your own calculator to class every day.
- I have a few extra calculators that stay in the room that you can borrow on a first-come-first-served basis, but you can't count on these being available.
- If you don't have a calculator on a test day and all of mine are lent out, you must just take the test without a calculator which will result in a lower test score.
- We recommend the Ti-84 (any version)...best mix of capabilities and ease of use and all class examples will use Ti-84.
- You can use other calculator models (nSpire, Casio, HP) but then you are responsible for learning how to operate your calculator on your own (use YouTube videos as needed to teach yourself).

Paper/pencils and current unit required packet

- This is primarily a paper class (not online/laptop), so bring something to write with every day.
- Bring the Required Practice Packet for the current unit to class every day (we will be working some problems from it during class as part of the lessons).

Course procedures **(stricter this year - admin is focusing on reducing the number of students out during class time)**

Bathroom pass

- Only 1 student out of the room for the bathroom at a time.
- Must get the bathroom pass directly from me.
- No passes during the first and last 10 minutes of class (strict rule campus-wide this year).
- If you need to use the bathroom:
  - Bring your phone and give it to me.
  - I will sign you out on my sheet.
  - I will give you your phone back when you return.
- You can always leave immediately if you have an emergency, but I will ask you about it when you return.

Bathroom Schedule

	Lower C East	Upper C East	Lower C West	Upper C West	A Building	E Building	Cafeteria
0 Hour	Open	Closed	Closed	Closed	Open	Open	Open
1st Period	Open	Open	Open	Open	Open	Open	Closed
2nd Period	Open	Open	Open	Open	Open	Open	Closed
3rd Period	Open	Open	Open	Open	Open	Open	Open (EVIT students only)
4th Period	Open	Closed	Closed	Closed	Closed	Closed	Open
5th Period	Open	Closed	Closed	Closed	Open	Open	Open
6th Period	Open	Open	Open	Open	Open	Open	Closed
7th Period	Open	Open	Open	Open	Open	Open	Closed
8th Hour	Open	Closed	Closed	Closed	Closed	Open (Athletics Only)	Closed

Times Open:

0 Hour: 7:40am - 8:35am
1st Hour: 8:45am - 9:25am
2nd Hour: 9:50am - 10:30am
3rd Hour: 10:55am - 11:35am
During Lunch Hours: 11:50am - 1:25pm
6th Hour: 1:40pm - 2:20pm
7th Hour: 2:45pm - 3:30pm
8th Hour: 3:50pm - 4:30pm

Course procedures **(stricter this year - admin is focusing on reducing the number of students out during class time)**

Other passes

- If you need to go anywhere other than the bathroom, I need to write you a paper pass to that specific location.
- You'll need to leave your phone with me while you are out of the room.
- You'll need to return the paper pass to me signed by an adult at your destination.

Cellphones/headphones/ear buds

- All teachers have been directed to have cellphones "physically away from students bell-to-bell".
- Phones/electronics must stay in your backpack at all times during class.
- If I see a phone, I will confiscate it and return it to you at the end of the hour.
- There will be times when I want you to access the internet for educational reasons...you'll need to use your laptop for that.

Food/Drink

- No food out at any time (every period has at least one person with life-threatening food allergies).
- Water okay...other drinks okay if in covered container.

About me

- Married (Kristen)
- 2 kids (Rachel and Brian)
- Hobbies: watching movies/tv with my wife, and music (singing and playing piano, acoustic/electric guitar, bass)

- B.S. Electrical Engineering,
- M.Ed. Secondary Education (math)

- Electrical/Software Engineer for 20 years: Motorola (now General Dynamics), Orbital Sciences (now Northrup Grumman), Acoustic Imaging, EF Data, Intel) Some things I did:
  - Military radar systems
  - RF Communications systems design for space vehicles
  - Medical ultrasound design
  - Digital camera design
  - Media software (video, audio/video synchronization)
  - Freelance software engineering business.

About you

Survey:

- **Tell me what you prefer to be called.**
- **Tell me if you have seating preferences (and reason).**
- **Tell me a little about yourself!**

When finished - Stretch break!

Taking this course for college credit
(Go over the handout)

Please take the info sheet about college credit home
and discuss your options with your parents.

- It is very beneficial to be taking AP level classes in high school, whether or not you are taking them for college credit! Exposure to college level material early greatly increases the probability of you doing well in college!

- Whether it makes sense for you to pay money to get college credit now depends upon a number of factors - I've tried to discuss these fully in the handout.

Questions?

Homework / practice system:

- **We use a homework packet system: for each unit, there is a 'required' practice packet and an 'extra' practice packet:**

The 'required' packet counts for points towards your grade.

- **You must show work in your handwriting on the paper packet (or if you want to use a tablet, you can download the pdf from Canvas and complete the work in your tablet).**

- **The Required Practice packet is due on the day of the corresponding test.**

- **For full credit, required practice packets must have all problems completed with sufficient work shown.**

- **I will publish answers only (without work) for the required packet problems - you'll need to come up with your own work to solve these problems.**

- **All examples included in the lessons are part of your required practice packet, so bring your required packet every day and work the examples along with me during the lessons.**

The 'extra' packet is not checked for credit...

- **...but for each problem in the required packet there will be one or more similar problems in the extra packet for which I will publish full solutions with work shown.**

- **If you find that you are not scoring as high as you'd like on tests, consider doing all of the extra practice packet problems in addition to the required practice - more practice helps you work more quickly and confidently on tests :)**

When completing homework: Work a problem in required packet and check the answer. If you got it wrong or couldn't finish it, work the corresponding problem(s) in the extra packet and use published full solutions to learn. Then go back and rework the required problem.

General course structure

Daily procedures

Usual daily procedure:

1) New topic lesson

2) Questions for yesterday's homework / start working on homework in class.

Questions about the homework problems?

- **After the lesson is finished, we will often have a time when we can take questions from the previous day's homework. I'll usually put problems on the board and invite students to volunteer to work them for participation credit, or we will work problems in randomly assigned groups at the board.**

- **There will be a specific set of 'test review' problems given which let you know what is on each chapter test and similar problems for study.**

- **Tutoring: If you are unable to get all your questions answered during class, I am available in this classroom before or after school every school day except after school on Wednesdays (no appointment needed, just walk in).**

Grades

40% quarter 1, 40% quarter 2, 20% final exam

90% from measures of understanding: chapter tests

10% from measures of effort: mostly from checked homework

You can find information about our course in 2 places:

1) Canvas

2) General internet website: www.mrfelling.com

Content is mirrored on both sites, so you can use either or switch to the other one if one becomes unavailable.