

Calculus III (Fall 2019, Sections 05 and 06)

This is a website built for math323-05-f19 and math323-06-f19. If you have an idea to improve this space, please email eppolito-at-math-dot-binghamton-dot-edu with your suggestion; I would like this space to be as useful to students as possible...

General Information

The official course page is at the following link:

https://www2.math.binghamton.edu/p/calculus/math_323/start.

Its contents are our syllabus.

Contact Information

Your instructor is Chris Eppolito (hey, that's me!). Email me at eppolito-at-math-dot-binghamton-dot-edu for anything regarding this class. Be sure to include your name and section number in the email.

Meetings

Section 5: MWF 14:50 - 16:20 in LH 3

Section 6: MWF 16:40 - 18:10 in CW 323

Office Hours

Our help room for this class is WH 233. Please see the schedule for my hours. I can also meet by appointment (email me to set up an appointment).

You can visit any Calculus III instructor in the help room, and I encourage you to do so! Different folks think differently; maybe someone else thinks more like you, and you can get help from them too.

Textbook

Multivariable Calculus (8e) by Stewart

The textbook (as an e-book) comes with a subscription to WebAssign, so just get that...

Grading

See the [official grading distribution](#).

Content

Reasoning in three dimensions. Calculus of functions in several variables. We will cover most of chapters 12 - 16 in the textbook, together with some small excursions as I see fit.

Homework

This class uses WebAssign for online homework assignments. You are expected to check WebAssign daily, and to know when assignments are due. *I will NOT notify you of assignment due dates* (all due dates are already posted).

Email me if you need the key to our class in WebAssign.

Written Homework

I sometimes assign written homework to collect in class.

Practice Problems

Here are some practice problems (updated 16 November 2019) I like. Check back for updates...

Quizzes

Quizzes will be given frequently throughout the course. Quizzes are intended to check that you understand basic concepts from previous classes and from assigned reading.

I typically grade quiz questions on a 5-point scale. The following is a ROUGH guide to interpreting each score.

- **5:** Understands concept, with minor errors
- **4:** Mostly understands concept, with errors in execution or minor misunderstanding
- **3:** Conceptual misunderstanding present, but not yet serious
- **2:** Major conceptual misunderstandings, with shallow understanding (if any)
- **1:** Mostly nonsense, with serious errors
- **0:** Demonstrates no understanding of the topic

Useful Software

Here are some useful technological tools for this class, together with some descriptions.

- Mathpix is a browser 3D graphing calculator. The interface is self explanatory, produces very nice pictures, and doesn't use a lot of computing power.
- GeoGebra is a math learning software (that link is to the browser 3D graphing calculator). You can download a copy (for Linux, Mac, or Windows) and write your own sheets, too! There is a learning curve...
- Academo is a browser 3D graphing calculator. It provides nice shading, but has a limited rotation.

Schedule

This section is a record of what I have covered and plan to cover in my sections. See also the [official schedule](#).

21 August 2019 W

- First-day stuff
 - Discussed the syllabus
 - Introductions from students
- Geometry in three dimensions (textbook section 12.1)
 - Proved the Distance Formula.
- Homework
 - Read: Textbook sections 12.1 and 12.2
 - Do: Attempt practice problems

23 August 2019 F

- Vectors and Vector Operations (textbook section 12.2)
 - Algebraic and geometric descriptions of vectors
 - Addition and scalar multiplication operations on vectors
 - Algebraic properties of vector addition and scalar multiplication
- Homework
 - Read: Textbook section 12.3
 - Do: Attempt practice problems

26 August 2019 M

- The Dot Product (textbook section 12.3)
 - Algebraic definition of the dot product
 - Algebraic properties of the dot product
 - Geometric interpretation of the dot product and consequences
- The Cross Product (textbook section 12.4)
 - Briefly constructed the cross product as a particular vector orthogonal to two given vectors
- Homework
 - Read: Textbook sections 12.4 and 12.5
 - Do: Attempt practice problems

28 August 2019 W

- The Cross Product (textbook section 12.4)
 - Construction as a “determinant”
 - Algebraic Properties
 - Geometric Properties
- Lines and Planes in 3-Space (textbook section 12.5)
 - Lines

- Vector parametrizations
- Coordinate functions
- Symmetric equations
- Planes
 - Vector sums of non-parallel vectors
 - Normal vector to a plane
- Homework
 - Do: Attempt practice problems

30 August 2019 F

- Brief review of lines and planes in 3-space
- Problem Session on Chapter 12
- Homework
 - Read: Textbook sections 12.6 and 13.1
 - Do: Play with quadric surfaces and curves in 3-space--use a 3D graphing calculator as you read!
- **Written Homework**: Complete these exercises--Due 6 September 2019

2 September 2019 M

No Classes (Labor Day: Don't wear white after today?)

4 September 2019 W

- Quadratic Surfaces (textbook section 12.6)--The links below are to GeoGebra sheets I made for class; play with the parameters to get a feel for quadratic surfaces.
 - Ellipsoid
 - Elliptic Paraboloid
 - Hyperbolic Paraboloid
 - One Sheet Hyperboloid
 - Cone
 - Two Sheet Hyperboloid
 - Hyperboloids connected through a cone
- Vector Functions and Curves in 3-Space (textbook section 13.1)
 - Vector function definition
 - Limits of vector functions
 - Examples
 - Helix
 - Trefoil Knot
- Homework:
 - Read: Textbook sections 13.1 and 13.2
 - Do: Attempt practice problems

6 September 2019 F

- Collected Written Homework 1
- Recap of Vector Functions (textbook section 13.1)
- Calculus of Vector Functions (textbook section 13.2)
 - Running Example: Moment Curve
 - Properties of the Limit
 - Definition and Properties of the Derivative
 - Definition and Properties of the Integral
- Homework
 - Read: Textbook section 13.3 (with special attention to arc length)
 - Do: Attempt practice problems
 - Study: Start studying for Midterm 1

9 September 2019 M

- Arc Length of Space Curves (textbook section 13.3)
 - Derivation of Formula
 - Examples to Computing Arc Length
 - Reparametrizing a Curve by Arc Length
- Homework
 - Do: Attempt practice problems
 - Study: Study (harder?) for Midterm 1

11 September 2019 W

- Motion in Space (textbook section 13.4)
 - Problem Session on Vector Functions and Space Curves
- **NB**: End material for Midterm 1.
- Homework
 - Do: Attempt practice problems
 - Study: Study for Midterm 1.

13 September 2019 F

- Multivariable Functions (textbook section 14.1)
 - Multivariable Function Plotter
 - Contour Map Visualization
 - Another Contour Plot
- Limits and Continuity of Multivariable Functions (textbook section 14.2)
 - Definition of the Limit (with much motivation!)
- Homework
 - Study: Study for Midterm 1.

16 September 2019 M

- Review Session for Midterm 1

- Student Questions Only
- Study: Study for Midterm 1

18 September 2019 W

- **Midterm 1 in Class**
 - Content: Chapters 12 and 13 (omitting curvature and normal/binormal vectors)

20 September 2019 F

- Limits and Continuity of Multivariable Functions(textbook section 14.2)
 - Review the definition of the limit
 - The Curves Criterion for Limits
 - Lots of examples
 - Here are two more examples...
- Homework
 - Read: Textbook sections 14.1 and 14.2; get started on 14.3

23 September 2019 M

- Derivatives of Multivariate Functions
 - Partial Derivatives (textbook section 14.3)
 - Definition and intuition
 - Computational aspects
 - Examples
 - Directional Derivatives (textbook section 14.6)
 - Definition and intuition
 - Examples
 - Differentiability of Multivariate Functions
 - Definition and intuition
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 14.3 and 14.6

25 September 2019 W

- More on Derivatives of Multivariate Functions
 - Directional Derivatives in terms of Partial Derivatives
 - Clairaut's Theorem on Mixed Partial Derivatives
- Homework
 - Do: Attempt practice problems
 - Read: Textbook section 14.4

27 September 2019 F

- Tangent Planes and Linear Approximation (textbook section 14.4)

- Problem session
- Homework
 - Do: Attempt practice problems
 - Read: Textbook section 14.5

30 September 2019 M

- No class (Rosh Hashanah: Happy New Year!)

2 October 2019 W

- Multivariable Chain Rule (textbook section 14.5)
 - Derivation for the 2-variable case
 - Statement of the chain rule
 - Many examples
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 14.6 (on gradient) and 14.7

4 October 2019 F

- Gradient (textbook section 14.6)
 - The gradient maximizes the directional derivative!
- Maxima and Minima (textbook section 14.7)
 - Finding critical points
 - Classifying critical points with the Second Derivative Test
 - Many examples
- Homework
 - Do: Attempt practice problems
 - Read: Textbook section 14.8

7 October 2019 M

- Lagrange Multipliers (textbook section 14.8)
 - Statement of the method
 - Examples applying the method
 - Here is another example.
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 15.1, 15.2, and 15.3
 - Study: Start studying (harder?) for Midterm 2

9 October 2019 W

- No Class (Yom Kippur: Sorry, no class today...)

11 October 2019 F

- Another Lagrange Multipliers example
- Double Integrals
 - Rectangular Domain (textbook section 15.1)
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 15.1, 15.2, and 15.3
 - Study: Study for Midterm 2

14 October 2019 M

- Double Integrals
 - General Domain (textbook section 15.2)
 - Polar Coordinates (textbook section 15.3)
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 15.1, 15.2, and 15.3
 - Study: Study for Midterm 2
- **NB**: End content for Midterm 2

16 October 2019 W

- Double Integrals
 - Problem Session
- Homework
 - Study: Study for Midterm 2

18 October 2019 F

- Triple Integrals (textbook section 15.6)
 - Too many examples
 - Application to Physics: Center of Mass
- Homework
 - Study: Study for Midterm 2

21 October 2019 M

- Review Session for Midterm 2
 - Student Questions Only
- Homework
 - Study: Study for Midterm 2

23 October 2019 W

- **Midterm 2 in Class**

- Content: Chapters 14 and 15.1–15.3

25 October 2019 F

- Cylindrical Coordinates (textbook section 15.7)
- Spherical Coordinates (textbook section 15.8)
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 15.6, 15.7, and 15.8; get started reading textbook section 15.9

28 October 2019 M

- Change of Variables (textbook section 15.9)
 - Unifying the differentials with Jacobians!
- Homework
 - Do: Attempt practice problems
 - Read: Textbook section 15.9

30 October 2019 W

- Change of Variables (textbook section 15.9)
 - Lots of examples
 - Here are solutions...
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 16.1

1 November 2019 F

- Vector Fields (textbook section 16.1)
- Line Integrals (textbook section 16.2)
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 16.2 and 16.3

4 November 2019 M

- More on line integrals
 - Too many examples
- Fundamental Theorem of Line Integrals (textbook section 16.3)
 - Do: Problem assigned in class
 - Read: Textbook section 16.4

6 November 2019 W

- Green's Theorem (textbook section 16.4)
 - Statement and Explanation (proof omitted)

- Many Examples
- Homework
 - Do: Attempt practice problems
 - Read: Textbook section 16.5

8 November 2019 F

- Curl and Divergence (textbook section 16.5)
 - Definitions
 - Many examples
 - Fundamental properties
- **NB**: End content for Midterm 3
- Homework
 - Do: Attempt practice problems
 - Read: Textbook sections 16.6 and 16.7
 - Study: Start studying (harder?) for Midterm 3

11 November 2019 M

- Parametric Surfaces (textbook section 16.6)
 - Examples
 - Tangent planes from parametrizations
 - Surface areas from parametrizations
- Homework
 - Do: Attempt practice problems
 - Study: Study for Midterm 3

13 November 2019 W

- Surface Integrals (textbook section 16.7)
 - Examples
- Homework
 - Study: Study for Midterm 3

15 November 2019 F

- Review Session for Midterm 3
 - Student Questions Only
- Homework
 - Study: Study for Midterm 3

18 November 2019 M

- **Midterm 3 in Class**
 - Content: Chapters 15.6–15.9 and 16.1–16.5

20 November 2019 W

- Stokes's Theorem (textbook section 16.8)
- Homework
 - Do: Attempt practice problems from the textbook
 - Read: Textbook section 16.8
 - Study: Study for the CUMULATIVE Final

22 November 2019 F

- More on Stokes's Theorem
 - Problem session
- Homework
 - Do: Attempt practice problems from the textbook
 - Read: Textbook sections 16.9
 - Study: Study for the CUMULATIVE Final

25 November 2019 M

- Divergence Theorem (textbook section 16.9)
- Homework
 - Do: Attempt practice problems from the textbook
 - Study: Study for the CUMULATIVE Final

27 November 2019 W

No Class (Find-a-T(of)urkey Day: Safe travels!)

29 November 2019 F

No Class (Recover-from-Turkey Day: Heat up those leftovers...)

2 December 2019 M

Classes Cancelled by the University for SNOW reason

4 December 2019 W

- Review Session for Final
 - Student Questions Only
 - Study: Study for CUMULATIVE Final

6 December 2019 F

No Class (Reading Day: Read your favorite calculus textbook/notebook!)

12 December 2019 R

- FINAL EXAM!
 - **Exam Room:** LH 001
 - **Exam Time:** 15:15 - 17:15

From:
<http://www2.math.binghamton.edu/> - **Binghamton University Department of Mathematical Sciences**

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