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...

THIS PAGE IS NO LONGER UPDATED

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 Multivaraible 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 Multivaraible 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