Stony Brook University
Mathematics Department
Julia Viro

MAT 132
Calculus II
Spring 2021

Syllabus

Course description (from Undergraduate Bulletin): A continuation of MAT 131, covering symbolic and numeric methods of integration; area under a curve; volume; applications such as work and probability; improper integrals; sequences; series; Taylor series; differential equations; and modelling. May not be taken for credit in addition to MAT 127, MAT 142, MAT 171, or AMS 161. This course has been designated as a High Demand/Controlled Access (HD/CA) course. Students registering for HD/CA courses for the first time will have priority to do so.

Prerequisite: C or higher in AMS 151 or MAT 131 or 141, or level 7 on the mathematics placement examination

SBC: STEM+

Credits: 4

Textbook: Gilbert Strang *Calculus. Volume 2.* The book is available for free on Openstax:

https://openstax.org/details/books/calculus-volume-2

Instructors

• **Julia Viro** (course coordinator)
Lectures: TuTh 9:45am-11:05am
E-mail: julia.viro@stonybrook.edu
MLC hours: Tu 12noon-1pm
Office hours: Th 12noon-2pm
Zoom personal meeting room: https://stonybrook.zoom.us/j/9792031214

• **Holly Chen**
Lectures: MW 4:25pm-5:45pm
Recitations: R01 (MW 6:05-7:00pm), R03 (MW 10:30am-11:25am)
E-mail: holly@math.stonybrook.edu
MLC hours:
Office hours:
Zoom personal meeting room:

• **Willie Rush Lim**
Recitations: R02 (MW 2:40pm-3:35pm), R21(MW 10:30am-11:25am)
E-mail: lim.willie@stonybrook.edu
MLC hours: M 1:30pm-2:30pm
Office hours: W 12:00pm-1:00pm, W 4:00pm-5:00pm
Zoom personal meeting room: 5646113117

• **Manju Prakash**
Recitations: R04 (TuTh 1:15pm-2:10pm), R20 (TuTh 6:30pm-7:25pm)
E-mail: manju.prakash@stonybrook.edu
MLC hours: W 9am-10am
Office hours: TuTh 11am-12noon
Zoom personal meeting room: https://stonybrook.zoom.us/s/91697242714#success

• **Ajmain Yamin**
Recitations: R22 (TuTh 11:30am-12:50pm)
E-mail:ajmain.yamin@stonybrook.edu
MLC hours: M 11:30am-12:30pm, W 11:30am-12:30pm
Office hours: F 11:30am-12:30pm
Zoom personall meeting room:
https://stonybrook.zoom.us/j/5805273826?pwd=UExDeHFKanlLc0NpNFVLa3JHV0Jydz09

Learning activities:

• Watching prerecorded video episodes (Lec31)
• Lectures: Live discussions in Zoom meetings
• Recitations: Live discussions in Zoom meetings for all sections except R02 and R21 which meet in-person (with masks on)
• Online office hours of instructors
• Assessments: quizzes (on recitations), two Midterm exams, homework (through WebAssign), Final exam.

Blackboard. All course information will be posted to Blackboard on the sections of Syllabus, Course Documents and Assignments.

Gradescope is the grading platform for the course. The exams will be posted there. Your solutions should be uploaded to Gradescope.

WebAssign. WebAssign is the course homework platform. You need to purchase an access code for WebAssign (the first two weeks are free).

Weekly assignments (homework) will be given through WebAssign (due each Sunday 11:59 pm). You can access WebAssign through Blackboard (Course Tools → Access WebAssign).

Late submission of assignments is allowed but the score will be reduced.

Quizzes. Quizzes will be given in recitations. You have to attend the recitation meeting in order to take a quiz. Each quiz will contain the material of the previous week. See "Learning outcomes" below. The first quiz will be "Syllabus quiz". Make up of quizzes will not be given. Late submissions will not be graded.

Exams. Midterm 1 will be given on Week 5 (March 1-5), Midterm 2 - on Week 10 (April 5-9). For the content of Midterms consult "Learning outcomes" of respective periods.

The Final Exam will be given online on Wednesday, May 12th at 11:15am-1:45pm. The final exam will be proctored.

For the exams, you are required to have a webcam on your computer and stable internet connection. Complaints about technical difficulties during the exams will not be accepted. Exams submitted after the deadline will not be graded.

Missing one of the exams without any serious and documented reason will result to failure in the course.

To ensure integrity during the exams and quizzes, you may be asked to write your solution following special requirements which will be discussed in class. Solutions, even correct ones, written in different format will give no credit.

By the results of the exams, your instructor may call you to a personal Zoom meeting and validate that you are able to reproduce the online work you have submitted. By the results of this meeting, the grade may be changed.

Make-up policy. Make-up examination will be given only for work missed due to unforeseen circumstances beyond the student's control.

Grading System. The only basis for the grades of any student is academic performance of the student.

Your grade for the course will be based on: WebAssign (homework): 10%, Quizzes: 10%, Midterms: 25% each, Final Exam: 30%.

Standard grades' inflation techniques (dropping lowest grades, extra assignments to "boost" the grades, curving homework and exams grades and curving the course total (average), etc.) will not be applied in this course. The letter grade will be given by the end of the course for your genuine total score according the following **preliminary** scheme:

C-range: $40\% - 60\%$, B-range: $60\% - 85\%$, A-range: $85\% - 100\%$.

Calculators. Using calculators of various types on Midterm and Final exams is allowed only if this stated explicitly by the problem. Otherwise using calculators of any type will be considered as violation of academic integrity.

Where to get help. If you have any mathematical questions or concerns, your instructors are ready to help you. Please address to your recitation instructor (during his/her virtual office hours or by e-mail) or your lecturer (during virtual office hours or by e-mail).

Math Learning Center (**MLC**) is a virtual place where you can get free tutoring help with any of your math concerns. No appointment is required. Visit MLC at

http://www.math.stonybrook.edu/mlc/center-hours.html

Student Accessibility Support Center (SASC) statement:

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential. https://www.stonybrook.edu/commcms/studentaffairs/sasc/facstaff/syllabus.php

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website:

https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities

Academic integrity statement:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology and Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For

more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at:

http://www.stonybrook.edu/commcms/academic integrity/index.html

The following will be considered as acts of **academic dishonesty**:

- Using problems solving websites or phone apps to get solutions.
- Using any calculator or graphing utility unless it it not explicitly allowed by the problem.
- Getting help in any from from other people.
- Sharing solutions or/and answers with other people.

All cases of violation of academic integrity will be reported immediately to the Academic Judiciary. Students who admitted dishonesty will face

- failure of the course,
- a dishonesty report in the transcript, and
- an obligation to take the Q course.

Critical Incident Management Statement:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Student Absences Statement

Students are expected to attend every class, report for examinations and submit major graded coursework as scheduled. If a student is unable to attend lecture(s), report for any exams or complete major graded coursework as scheduled due to extenuating circumstances, the student must contact the instructor as soon as possible. Students may be requested to provide documentation to support their absence and/or may be referred to the Student Support Team for assistance. Students will be provided reasonable accommodations for missed exams, assignments or projects due to significant illness, tragedy or other personal emergencies. In the instance of missed lectures or recitations, the student is responsible for review posted videos, recorded lectures, and notes. Please note, all students must follow Stony Brook, local, state and Centers for Disease Control and Prevention (CDC) guidelines to reduce the risk of transmission of COVID. For questions or more information click here:

https://www.stonybrook.edu/commcms/comingback/students.php

Weekly plan (tentative) is presented below.

Week 1 (February 1-5)
Integration techniques

Video: Episode 1 (What an integral is),
Episode 2 (Integration by substitution),
Episode 3 (Integration by parts).

Learning objectives. The subject of Calculus II. Indefinite and definite integrals, the Fundamental Theorem of Calculus (remainder). Integration by substitution for indefinite and definite integrals. Integration by parts for indefinite and definite integrals.

Learning outcomes. A student should be able to
1. outline the scope of the course and list its main topics
2. describe various integration techniques and the situations when each technique is applicable
3. prove the formula for integration by substitution
4. evaluate integrals requiring integration by substitution
5. describe the cases when integration by substitution makes sense
6. handle inverse trigonometric substitution and apply them for area calculations
7. prove the formula for integration by parts
8. evaluate integrals requiring integration by parts
9. apply idea of recursive integration to obtain reduction formulas for integrals
10. use both techniques of integration in combination

Week 2 (February 8-12)
Integration rational and trigonometric functions

Video: Episode 4 (Integration rational function),
Episode 5 (Integration trigonometric functions).

Learning objectives. What a rational function is and how to integrate it. Technique of partial fractions decomposition. Combining partial fractions decomposition with other integration techniques. Trigonometric formula which are most often used for integration. Special integration tricks for trigonometric functions.

Learning outcomes. A student should be able to

1. explain what a rational function is
2. describe technique of partial fraction decomposition and apply it to rational functions
3. evaluate integrals using technique of partial fractions decomposition
4. use partial fractions decomposition in combination with other techniques of integration
5. apply various trigonometric formulas for integrating trigonometric functions
6. apply various integration techniques for integrating trigonometric functions
7. obtain recursive formulas for special classes of integrals.

Week 3 (February 15-19)
Average value of a function. Improper integrals

Video: Episode 6 (Average value of a function),
Episode 7 (Improper integrals of type I),
Episode 8 (Improper integrals of type II).

Learning objectives. Averaging discrete and continuous quantities. Average value of a function. The Mean Value Theorem. Two types of improper integrals and their geometric interpretation.

Learning outcomes. A student should be able to
1. comprehend the idea of averaging discrete and continuous quantities
2. explain what the average value of a function over interval is and interpret it geometrically
3. state The Mean Value Theorem for integrals and give its geometric interpretation
4. describe two types of improper integrals and provide their geometric interpretation
5. define improper integral as a limit
6. explain what convergent and divergent integrals mean
7. demonstrate various integration techniques for evaluation improper integrals
8. determine convergence or divergence of standard integrals
9. state the comparison theorem for improper integrals
10. apply the comparison idea for testing convergence/divergence of improper integrals

Week 4 (February 22-26)
Integrals for area and arc length calculations

Video: Episode 9 (Area between curves)
Episode 10 (Area enclosed by a polar curve)
Episode 11 (Area enclosed by a parametric curve)
Episode 12 (Arc length)

Learning objectives. Calculation of area enclosed by curves given by Cartesian, polar or parametric equations. Arc length of a curve given by Cartesian or polar equation. Using symbolic calculators for evaluation of definite integrals.

Learning outcomes. A student should be able to
1. describe areas of application of indefinite definite integrals in physics, geometry, and differential equations
2. use graphing utilities (like Desmos) for plotting Cartesian, polar, and parametric curves
3. express the area between two curves as a definite integral
4. express the area of a region enclosed by a polar curve as a definite integral
5. express the area of a region enclosed by a parametric curve as a definite integral
6. interpret geometrically the formula for arc length
7. calculate the arc length of a curve given as the graph of a function
8. calculate the arc length of a parametric curve
9. use symbolic calculators for evaluation of definite integrals

Week 5 (March 1-5) Midterm 1
Volumes of solids of revolution

Video: Episode 13 (Volumes by slicing)

Learning objectives. General principles of volume calculations. Three-dimensional solids of revolution

Learning outcomes. A student should be able to
1. distinguish one, two and three-dimensional objects
2. understand what a solid of revolution is
3. sketch simplest three-dimensional objects (ball, solid cylinder, cone, cube, etc.)
4. use graphing utilities to create solids of revolution
5. draw cross-sections of three-dimensional solids
6. express the volume of a three-dimensional solid of revolution as definite integral using slicing method

Week 6 (March 8-12)
Volumes of solids of revolution (cont.)
Application of integration to physics

Video: Episode 14 (Volumes by cylindrical shells)
Episode 15 (Mechanical work)
Episode 16 (How much work was needed to erect the Great Pyramid of Giza?)

Learning objectives. Calculation of volumes of solid of revolution using the method of cylindrical shells. Mechanical work in physics. Hooke's law. Work against gravity.

Learning outcomes. A student should be able to
1. apply method of cylindrical shells to calculate the volume of a solid of revolution
2. choose a right method for volume calculation
3. comprehend the physical concept of work done by a force
4. express the work as an integral
5. state Hooke's law and apply it in the simplest cases
6. calculate the work against the gravity

Week 7 (March 15-19)
Introduction to differential equations

Video: Episode 17 (Introduction to differential equations. Separable equations)
Episode 18 (Direction fields and integral curves)

Learning objectives. What a differential equation is. Types of differential equations. Solution of a differential equation. Geometric interpretation of a differential equation (direction fields). Method of separation of variables.

Learning outcomes. A student should be able to
1. define what a differential equation is and interpret it geometrically
2. explain what a general solution of an differential equation is
3. plot the direction field and solution curves of a differential equation using graphing utilities
4. apply method of separation of variables to solve differential equations
5. understand what the initial problem for a differential equation is and solve initial value problems
6. determine equilibrium solutions of a differential equation.

Week 8 (March 22-26)
Orthogonal trajectories and Euler's method

Video: Episode 19 (Orthogonal trajectories)
Episode 20 (Euler's method)

Learning objectives. Orthogonal family of curves. Differential equations to find orthogonal trajectories. Euler's method for finding an approximate solution of an initial value problem.

Learning outcomes. A student should be able to
1. define what it means for curves to be orthogonal
2. explain what a family of curves is
3. draw a family of curves by hand and using graphing utilities
4. compose and solve the differential r]equation for orthogonal trajectories, interpret the obtained

solution and check if it's plausible
5. draw the orthogonal family of curves on the same coordinate system
6. understand how Euler's method works and apply it to initial value problems
7. provide a geometric interpretation of Euler's method

Week 9 (March 29-April 2)
Mixing, cooling, exponential growth and decay, logistic equation.

Video: Episode 21 (Mixing problems)
Episode 22 (Newton's law of cooling)
Episode 23 (Exponential growth and decay)
Episode 24 (Logistic equation)

Learning objectives. How to set up an initial value problem for a differential equation after word description. Mixing problems. Newton's law of cooling. Exponential growth and decay.

Learning outcomes. A student should be able to
1. compose an initial value problem for a differential equation after verbal description
2. set up and solve a mixing problem
3. comprehend Newton's law of cooling and apply it to compose and solve differential equations
4. work with exponential models for growth and decay.

Week 10 (April 5-9) Midterm 2
Differential equation of second order

Video: Episode 25 (Second-order differential equations)

Learning objectives. Second-order homogenuous linear differential equations with constant coefficients.

Learning outcomes. A student should be able to
1. identify a second-order homogenuous linear differential equations with constant coefficient
2. understand a linear character of the solutions
3. check if two solutions are linearly independent
4. compose the characteristic equation
5. determine two linear independent solutions from the roots of the characteristic equation
6. set up the general solution
7. solve initial value problems.

Week 11 (April 12-16) Sequences and series

Video: Episode 26 (Sequences)
Episode 27 (Model sequences)
Episode 28 (Limit of a sequence)
Episode 29 (Series)

Learning objectives. Numerical sequences. Limit of a sequence. Harmonic and geometric sequences. Asymptotic behavior of model (standard) sequences. Series. Convergent and divergent series.

Learning outcomes. A student should be able to
1. explain what a numerical sequence is
2. exploit different ways of describing sequences: by general term, and by recursive formula

3. relate a sequence and its extension function
4. identify harmonic and geometric sequences
5. use correctly terminology related to sequences: increasing, decreasing, monotonic, positive, alternating, bounded above, bounded below
6. define the limit of a sequence and list the properties of the limit
7. compare asymptotic behavior of logarithmic, power, exponential and factorial sequences
8. distinguish a sequence and a series
9. construct a sequence of partial sums for a series
10. define what it means that a series converges or diverges
11. explain what the sum of a series is
12. work fluently with geometric, harmonic, and telescoping series

Week 12 (April 19-23)
Convergence and divergence of series

Video: Episode 30 (Divergence Test and other theorems about series)
Episode 31 (Convergence tests: integral, comparison, and limit comparison)
Episode 32 (Ratio and root tests)
Episode 33 (Alternating series test)

Learning objectives. Divergence test. Convergence tests for positive series: comparison, limit comparison, integral, ratio, root. Alternating series. Absolute and conditional convergence.

Learning outcomes. A student should be able to
1. perform divergence test for series
2. list various convergence tests and understand how they work
3. apply comparison, limit comparison, integral, ratio, root test for series
4. formulate and apply alternating series test
5. be familiar with notions of absolute and conditional convergence
6. demonstrate practical skills in choosing suitable tests for series

Week 13 (April 26-30).
Power series and their applications.

Video: Episode 34 (Power series: radius and interval of convergence)
Episode 35 (Operations on power series)
Episode 36 (Presentation of functions as power series)
Episode 37 (Applications of power series)

Learning objectives. Power series. Theorem about convergence of a power series. Radius and interval of convergence. Operations with power series. Presentation of functions by power series. Applications of power series.

Learning outcomes. A student should be able to
1. identify a power series
2. state and prove theorem about convergence of a power series
3. determine the radius and interval of convergence of a power series
3. demonstrate proficiency in differentiation and integration of power series
4. establish power series for some basic functions
5. express Gauss error function as a power series
6. use power series to calculates limits, sums and integrals.

Week 14 (May 3-7)
Taylor series and their applications

Video: Episode 38 (Taylor series)
Episode 39 (Taylor polynomial)
Episode 40 (Taylor series for trigonometric functions)
Episode 41 (Binomial series)
Episode 42 (Applications of Taylor series)

Learning objectives. Taylor series of a function at a point. Maclaurin series. Taylor polynomial. Maclaurin series for basic functions.

Learning outcomes. A student should be able to
1. define Taylor series of a function at a point
2. define Maclaurin series
3. apply differentiation and integration of known series to get new expansion
4. establish Taylor and Maclaurin series for exponential, trigonometric, logarithmic functions
5. obtain a formula for binomial expansion
6. apply Taylor series for calculation of sums, limit and integrals.