Stony Brook University
Mathematics Department
Julia Viro

MAT 132
Calculus II
Fall 2023

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: Stewart/Kokoska *Calculus: Concepts and Contexts,* 5th edition.

Instructors:

• **Julia Viro** (course coordinator)
Lectures (Lec 02): TuTh 10:00am-11:20am Engineering 145
E-mail: julia.viro@stonybrook.edu
MLC hours (Math Building S-235): Tu 11:30am-12:30pm
Office hours (Math Building 5-110): Tu 1pm-2pm, Th 11:30am-12:30pm and 1pm-2pm.
Julia Viro Zoom personal meeting room

• **Qi Yao**
Lectures (Lec 01): MW 4:00pm-5:20pm Engineering 145
E-mail: qi.yao@stonybrook.edu
MLC hours (Math Building S-235):
Office hours (Math Building 3-116):
Qi Yao Zoom personal meeting room:

• **Austin Konkel**
Recitations: R110/210 MW 9:00am-9:53am Frey Hall 328
R118/218 MW 5:30pm- 6:23pm Physics P112
E-mail: austin.konkel@stonybrook.edu
MLC hours (Math Building S-235): M 10:00pm-12:00noon
Office hours (Math Building 5-125A): M 12:00noon-1:00pm
Zoom personal meeting room:

• **Shuhao Li**
Recitations: R112/212 MW 10:00am-10:53am Frey Hall 328
R115/215 MW 2:30pm- 3:23pm Chemistry 128
E-mail: shuhao.li@stonybrook.edu
MLC hours (Math Building S-235): MW 1pm-2pm
Office hours (Math Building 2-109): M 2:30pm-3:30pm
Shuhao Li Zoom personal meeting room

• **Hanbing Fang**
Recitations: R113/213 W 11:00pm-1:53pm Chemistry 128
RR151/251 MF 10:00am-10:53am Library N4006
E-mail: hanbing.fang@stonybrook.edu
MLC hours (Math Building S-235): W 11:00am-12:00noon
Office hours (Math Building 2-105): MF 9:00am-10:00am or by appointment
Hanbing Fang Zoom personal meeting room Meeting Number 488 301 0160, Password 104286

• **Danfei Wang**
Recitations: R123/223 TuTh 1:00pm - 1:53pm Earth and Space 183
R125/225 TuTh 5:30pm- 6:23pm Physics P112
E-mail: danfei.wang@stonybrook.edu
MLC hours (Math Building S-235): TuTh 4:00pm-5:00pm
Office hours: W 2:00pm-3:30pm
Danfei Wang Zoom personal meeting room

• **Eunice Ng**
Recitations: R130/230 WF 10:00am-10:53am Physics P112
R131/231 WF 11:00am-11:53am Lgt Engr Lab 152
E-mail: eunice.ng@stonybrook.edu
MLC hours (Math Building S-235): Tu 10:00am-11:00am, W 1:00pm-2:00pm
Office hours (Math Building S-240A): F 12:00noon-1:00pm
Eunice Ng Zoom personal meeting room

Brightspace. All course information will be posted to Brightspace.

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

Quizzes. Weekly quizzes will be given in recitations. You have to attend recitation meetings to take quizzes. For the content of each quiz, consult Brightspace. Make-up of quizzes will not be given.

Exams.

Midterm 1	Wednesday 10/4	8:30pm-9:50pm
Midterm 2	Thursday 11/9	8:30pm-9:50pm
Final	Wednesday 12/13	2:15pm-5:00pm

For the content of exams consult "Learning outcomes" of respective periods and practice exam review sheets.

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

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): 5%, Quizzes: 10%, Midterms: 25% each, Final Exam: 35%.

Standard grades' inflation techniques (dropping lowest grades, extra assignments to "boost" the grades, curving homework and exams grades and curving the course total, 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. Calculators will NOT be allowed on the exams. Some homework problems may require a calculator, though. Google calculator will serve all your needs.

You are encouraged to use any 2D and 3D graphing utilities that will help you to visualize the material (but not on the exams!)

Using calculators on quizzes and exams will be considered as violation of academic integrity (see Academic integrity statement below).

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 office hours or by e-mail) and/or your lecturer (during office hours or by e-mail).

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

MLC

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.

SASC

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:

Evacuation guide for people with physical disablilities

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

Academic Integrity

The following will be considered as acts of **academic dishonesty** during quizzes and exams:

- Using problems solving websites or phone apps to get solutions.
- Using calculators of any type including symbolic calculators and graphing utilities unless it it not explicitly allowed by the problem.
- Using any notes and textbooks
- 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 for the first time 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.

Student Support Team

Weekly plan (tentative) is presented below.

Week 1 (August 28 - September 1)
Integration techniques

Learning objectives. The subject of Calculus II. Indefinite and definite integrals, the Fundamental Theorem of Calculus (remainder). Average value of a function. The Mean Value Theorem. 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. 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 various integration techniques and the situations when each technique is applicable
5. prove the formula for integration by substitution
6. evaluate integrals requiring integration by substitution
7. describe the cases when integration by substitution makes sense
8. handle inverse trigonometric substitution and apply them for area calculations
9. prove the formula for integration by parts
10. evaluate integrals requiring integration by parts
11. use substitution and integration by parts in combination
12. apply idea of recursive integration
13. obtain and use reduction formulas for integrals.

Week 2 (September 4-8, no classes on Monday 9/4 - Labor Day)
Integration rational and trigonometric functions

Learning objectives. Rational functions. 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 (September 11-15) Improper integrals

Learning objectives. Two types of improper integrals and their geometric interpretation.

Learning outcomes. A student should be able to
1. describe two types of improper integrals and provide their geometric interpretation
2. define improper integral as a limit
3. explain what convergent and divergent integrals mean
4. demonstrate various integration techniques for evaluation improper integrals
5. determine convergence or divergence of standard integrals
6. state the comparison theorem for improper integrals
7. apply the comparison idea for testing convergence/divergence of improper integrals.

Week 4 (September 18-22)
Integrals for area and arc length calculations

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 (September 25-29)
Volumes of solids of revolution

Learning objectives. General principles of volume calculations. Three-dimensional solids of revolution. Calculation of volumes using methods of slicing and cylindrical shells.

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
7. apply method of cylindrical shells to calculate the volume of a solid of revolution
8. choose a right method for volume calculation
9. use method of slicing to calculate volumes of solids which are not solids of revolution.

Week 6 (October 2-6) Midterm 1 (Wednesday 10/4 at 8:30pm-9:50pm)
Application of integration to physics

Learning objectives. Mechanical work in physics. Hooke's law. Work against gravity.

Learning outcomes. A student should be able to
1. comprehend the physical concept of work done by a force
2. express the work as an integral
3. state Hooke's law and apply it in the simplest cases
4. calculate the work against the gravity.

Week 7 (October 9-13, no classes Monday 10/9 and Tuesday 10/10 - Fall Break)
Introduction to differential equations

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. 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 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
7. define what it means for curves to be orthogonal
8. explain what a family of curves is
9. draw a family of curves by hand and using graphing utilities
10. compose and solve the differential r]equation for orthogonal trajectories, interpret the obtained solution and check if it's plausible
11. draw the orthogonal family of curves on the same coordinate system
12. understand how Euler's method works and apply it to initial value problems
13. provide a geometric interpretation of Euler's method.

Week 8 (October 16-20)
Modeling with differential equations

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. Logistic model.

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 and adjusted exponential models for growth/decay
5. solve the IVP arising from the logistic model and interpret the resulting solution.

Week 9 (October 23-27) Differential equation of second order

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
8. solve applied problems about simple harmonic oscillations.

Week 10 (October 30 - November 3) Sequences and 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 11 (November 6-10) Midterm 2 (Thursday 11/9 at 8:30pm-9:50pm)
Convergence and divergence of series

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. use error estimate for positive and alternating series
6. be familiar with notions of absolute and conditional convergence
7. demonstrate practical skills in choosing suitable tests for series.

Week 12 (November 13-17) Power series

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

Learning outcomes. A student should be able to
1. identify a power series
2. state 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.

Week 13 (November 20-24, no classes Wednesday 11/22- Friday 11/24 -Thanksgiving Break)
Applications of power series.

Learning objectives. Presentation of functions by power series. Applications of power series.

Learning outcomes. A student should be able to
1. establish power series for some basic functions
2. express Gauss error function as a power series
3. use power series to calculates limits, sums and integrals.

Week 14 (November 27-December 1)
Taylor series and their applications

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. define Taylor and Maclaurin polynomials
4. give an error estimate for approximating a function by its Taylor polynomial

5. apply differentiation and integration of known series to get new expansion
6. establish Taylor and Maclaurin series for exponential, trigonometric, logarithmic functions
7. obtain a formula for binomial expansion
8. apply Taylor series for approximating the values of functions, calculation of sums, limit and integrals.

Week 15 (December 4-8) Review for the Final Exam

Week 16 (Monday, December 11) Review for the Final Exam

Final Exam is on **Wednesday 13th at 2:15pm-5:00pm.**