

MAT 127: Calculus C, Spring 2022
Midterm I Information

Thursday, 02/24, 8:15-9:35pm, Engineering 143

General Information

- (1) *You must bring your Stony Brook ID card to the exam.*
- (2) Please show up no later than 8:10pm. The exam will begin at 8:15pm and you will not receive extra time if you show up after 8:10pm.
- (3) Please take every other seat starting with the front row. Once a row fills up, please take a seat *directly* behind another person (not diagonally from another person). You can put your bag and/or jacket on one of the seats next to you in the same row.
- (4) You will receive an exam booklet (6 pages stapled together), with questions and plenty of space for solutions. Scrap paper will be available upon request. You can staple additional sheets to your exam booklet, but if you do so, please write your name and ID number on each additional sheet and indicate in the exam booklet where to find your solution. Any scrap paper that you do not want to be graded should not be handed in (except separately from the exams, for recycling). The exact front cover of the exam (except for the grade box) is at the end of this handout; if you have any questions about the instructions, please ask your instructor before the exam.
- (5) No notes, books, calculators, or cell phones may be used during the exam. Please bring pencils/pens and an eraser. The *only* items that may be on your desk are pencils/pens, an eraser, exam booklet, and the scrap paper provided by the proctors.
- (6) When you receive the exam, please do not open it until the proctors say it is time to start. However, please do fill in your name and Stony Brook ID number and circle your section number on the front cover of the exam.
- (7) All problems on the exam should be stated unambiguously. If you feel there is an issue with a statement of a particular problem, please let a proctor know; however, the proctor will not confirm whether your interpretation of the problem is correct.
- (8) When you are finished with the exam or when the time is called (whichever comes first), please take your exam booklet to the front along with your Stony Brook ID card. Put the booklet in the pile for your section and sign the photo roster under your picture immediately after. You can leave before the time is over, but please do so as quietly as possible and close the door very gently.
- (9) Out of fairness to others, please do not open your exam booklet ahead of time and stop working when the time is over. Your exam score will be reduced by 5 points per minute of either violation.

- (10) Copying answers from someone else or allowing someone else to copy your answers would constitute a major breach of the *University Student Conduct Code* and lead to very sad consequences. In particular, you would receive a 0 for the exam and be reported to the Academic Judiciary (which would likely lead to significantly more unpleasant consequences).

Before Midterm I

The midterm will cover Sections 2.8,4.1-4.4 from (Volume II of) the textbook and the *Notes on Second-Order Linear Differential Equations*. You should re-read these sections thoroughly, review *Course Summary I*, and study the solutions to PS1-4 (even if you did all/most problems correctly). Make sure you can do all numbered (non-lettered) exercises from these problem sets and the textbook problems from these sections.

The first midterm from Fall 09 is available on the course website, along with solutions. Please try doing this midterm in 90 minutes before looking at the solutions under full test conditions (no calculators, no solutions, no distractions). If you do not do well on this midterm, you should take this as a major warning. The first midterm in this class will be similar in many aspects to the Fall 09 midterm, though there will be some differences.

A lot of you have at least a rough idea as to what has been happening in the course, but some of you have difficulty implementing this in practice. As it is the latter which is important (and evaluated on the exams), it is essential to be able to do the textbook problems correctly. The only way to do this is to try to do as many of them as possible and at the very least make every effort to do the assigned exercises.

While this midterm will not be easy, do not be surprised if your score on the second midterm ends up being 10-15 points lower (a few of you may manage to raise your score by a few points or may drop it by 25-35 points, but 10-15 point drops are likely to be typical). If you do not do well on the first midterm, you'll have essentially no chance of passing this course; see Table 3 on page 7 in the *Additional Course Information* handout. So you need to prepare as much as possible for this midterm and to avoid making grievous errors on it, including those at the bottom of page 6 of the *Additional Course Information* handout; such errors will result in severe penalties and may lead to negative scores on individual problems.

If you have any questions, please come to office hours (lots of them Monday-Thursday!), MLC, and/or a Residential Tutoring Center.

After Midterm I

Detailed solutions to the midterm will be available on the course website on Friday morning; please print these out before the following lecture. If the solutions do not satisfactorily explain how your solution to a particular problem was graded, please check with the primary grader for the given problem (the primary graders for all problems will be listed on the website). You must bring a print-out of the solutions to the exam when you meet with the grader. Your exam grade will be changed, up or down, only if your problem was graded contrary to the grading scheme described in the solutions or inconsistently with others. If your total exam score was incorrectly tallied, please let your instructor know.

If you do not do sufficiently well on the first midterm, you should quickly consider your options:

- (1) drop down to MAT 126. This might be the best option, especially if you have not yet received credit for MAT 126. If you have received credit for MAT 126, you will not receive credit again, but you might be more prepared to take MAT 127 in the future.
- (2) drop down to MAT 132. This is a risky option, but might be better in the long run if it works out. MAT 132 moves faster than MAT 127, but starts earlier. So you'd see most of Chapter 4 again, but then MAT 132 will fly quickly through Chapters 5 and 6.
- (3) withdraw from MAT 127. You'd receive a W on your transcript and will need a retake permission from *Academic Advising* to repeat it.
- (4) put much more effort into MAT 127 in order to do much better on the second midterm and the final. Depending on how poor your early exam and midterm grades are, your schedule outside of MAT 127, and your priorities, this may not necessarily be a realistic option.

The deadline for (1) and (2) is Friday, March 4, and for (3) is Friday, April 1, but you should not procrastinate. The second midterm is on April 7 and so is too late to help with your decision. Of course, it would be best to avoid getting faced with one of these choices in the first place, so try to get ready for the first midterm as much as possible.

Background Material

You should be proficient at the topics covered by the early exam, especially the log and exponential rules and the methods of integration (substitution, integration by parts, and partial fractions). You can test your proficiency by doing the practice placement tests available on the math department website; you should aim for at least 90% on Parts 1 and 2 and 80% on Parts 3abc.

Types of Problems to Expect

The first midterm will have 5 problems, not of equal weight, with most problems sub-divided into parts of specified weight. The list below should fairly accurately describe the problems that may appear on the exam. Item (0) below is a collection of fundamental concepts that will be spread out throughout the exam, instead of constituting a single problem. Items (1)-(6) below are listed in the order they have appeared in the course, which is not necessarily the order in which they may appear on the exam. The problems on the midterm will not state what type they are; this will be up to you to figure out. Some problems may require minor algebraic manipulations to put them into the standard form for the type they are. For example a second-order differential equation may be written with some terms on RHS, or a first-order differential equation may become separable after moving some terms to RHS and factoring RHS. If you are asked to sketch anything, label the coordinate axes correctly; missing and incorrect labels will result in identical penalties. The problems on your midterm will be similar in style to the problems in the textbook and in *Notes on Second-Order Linear Differential Equations*, not to the letter problems on the problem sets. However, understanding solutions to the letter problems might be helpful.

- (0) *Fundamental Concepts*: verify a given function is a solution to a first- or second-order differential equation or initial-value problem; special properties of direction fields and solutions of autonomous equations. Examples: p362/3 1-47; Mif09 1,3,5.
- (1) *Qualitative behavior of solutions of first-order differential equations* (constant solutions, increasing/decreasing, graphs). You may be given 4 first-order differential equations and graphs of 4 functions, each solving precisely one of the differential equations. You may then need to match the differential equations to the graphs. This problem would be similar to HW1 I-2. One approach to such problems is to begin with the most distinguished graph identifying a mathematical feature which distinguishes it from the other three and checking that solutions of three of the differential equations cannot possess this property. You will not need to provide any justification for your answer. Your score will be based on the number of correct answers minus the number of repeats. Thus, matching all graphs to one equations (3 repeats) or to two equations (2 repeats) would guarantee no points for this problem.
- (2) *Direction fields*. Match a direction field diagram to a differential equation or sketch a direction field diagram for a given differential equation. Sketch solution curves with specified initial conditions in a direction field diagram. Examples: p377-9 66-93, Mif09 3.
- (3) *Euler's method*. You may be asked to use Euler's method to estimate the value of the solution to an initial-value problem at some specified value of the independent variable greater than the initial value. Either the number of steps or the step size would be specified. You would need to show the intermediate steps and carry out the computations using simple fractions (so $5/4$, not 1.25). You also need to understand the geometric meaning of Euler's method. Examples: p379/80 94-103; Mif09 4.
- (4) *Separable equations*. Find the general solution to a separable equation (or an equation that becomes separable after simple algebraic manipulations) or find the solution to an initial-value problem involving a separable equation. In the former case, make sure not to skip any of the constant solutions or to list any that correspond to some value of the constant C . A common mistake occurs from trying to do several steps at once when separating the variables; this may lead to a completely different and much easier problem, costing you *lots of points*. For

example, a common mistake turned the separable equation in Mif09 5 into $dy/y^2 = -9dx$. In order to avoid such mistakes, do one step at a time. For example, starting with

$$\frac{dy}{dx} = y^2 - 9,$$

first multiply LHS and the *entire* RHS by dx and then divide both sides by $y^2 - 9$. In order to do the resulting integral on LHS in this case, you'll need to use *partial fractions*; it is *not* $\ln|y^2 - 9|$. Examples: p391 119-142 ; Mif09 5.

- (5) *Applications (of separable equations)*. Find an equation of the curve of specified slopes; mixing problems; exponential growth/decay and logistic growth equations. You should remember the differential equations describing exponential growth/decay and logistic growth. You may also choose to memorize the exponential growth/decay and logistic growth equations (blue boxes on 232 and p401) and simply state them on the exam. If you follow this route, you must state the general form and specify what each of the symbols means before plugging in specific values, in order to receive full credit. Alternatively, you can obtain these formulas by re-solving the relevant separable equation. In either case, your final answer must have the correct physical units if appropriate. Examples: p241 348-369; p391/2 148-167; p405 168-188; Mif09 2.
- (6) *Second-order linear differential equations*. Find the general solution to a second-order homogeneous linear differential equation with constant coefficients (or an equation that becomes such after simple algebraic manipulations); find the solution to an initial-value problem involving such an equation. Examples: Notes 1-16; Mif09 1.

Above Mif09 and Notes refer to the first midterm from Fall 09 and to *Notes on Second-Order Linear Differential Equations* (all available from the course website), respectively.

If you want to get really ready for the midterm, do *every* problem listed above. This would likely go slowly at first, but with some practice these problems should go rather fast after a while.

MAT 127

Midterm I

February 24, 2022

8:15-9:35pm

Name: _____
first name *first*

ID: _____

Section: L01 L02 L03 (circle yours)
 MW 4:25-5:45pm TuTh 9:45-11:05am TuTh 1:15-2:35pm

DO NOT OPEN THIS EXAM YET

Instructions

- (1) Fill in your name and Stony Brook ID number and circle your lecture number at the top of this cover sheet.
- (2) This exam is closed-book and closed-notes; no calculators, no phones.
- (3) Please write legibly to receive credit. Circle or box your final answers. If your solution to a problem does not fit on the page on which the problem is stated, please indicate on that page where in the exam to find (the rest of) your solution.
- (4) You may continue your solutions on additional sheets of paper provided by the proctors. If you do so, please write your name and ID number at the top of each of them and staple them to the back of the exam (stapler available); otherwise, these sheets may get lost.
- (5) Anything handed in will be graded; incorrect statements will be penalized even if they are in addition to complete and correct solutions. If you do not want something graded, please erase it or cross it out.
- (6) Leave your answers in exact form (e.g. $\sqrt{2}$, not ≈ 1.4) and simplify them as much as possible (e.g. $1/2$, not $2/4$) to receive full credit.
- (7) Show your work; correct answers only will receive only partial credit (unless noted otherwise).
- (8) Be careful to avoid making grievous errors that are subject to heavy penalties.
- (9) If you need more blank paper, ask a proctor.

Out of fairness to others, please **stop working and close the exam as soon as the time is called**. A significant number of points will be taken off your exam score if you continue working after the time is called. You will be given a two-minute warning before the end.