**Instructor:** Prof. Boaz Ilan  
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**Discussion Section Leaders:**  
Ms. Elibet Ambrocio, eambrocio@ucmerced.edu  
Mr. David Hambley, dhambley@ucmerced.edu  
Mr. Nitesh Kumar, nkumar4@ucmerced.edu

**Lectures Time & Location:** MWF, 12:00 – 12:50 pm, COB 120, Ilan

**Discussion Sections Time & Location:**  
001: Thursday 6:30 pm – 8:20 pm, COB 282, Ambrocio  
002: Thursday 11:00 am – 12:50 pm, COB 127, Kumar  
003: Thursday 1:00 pm – 2:50 pm, COB 262, Hambley  
004: Thursday 4:30 pm – 6:20 pm, COB 264, Ambrocio  
005: Friday 1:30 pm – 3:20 pm, COB 274, Kumar

**Office hours:**  
Ilan: Monday 1 – 2 pm or by appointment, S&E 334  
Ambrocio: Thursday 2 – 4 pm, AOB 112  
Hambley: Friday 10:30 – 11:30 am, AOB 112  
Kumar: Tuesday 10 – 12 noon, AOB 160

**Learning Objectives:** Upon completion of this course, students should understand:

- The benefits of solving initial value problems using analytical, numerical and qualitative methods.
- How to apply and interpret differential equations in the context of real-world examples.
- The purpose of analyzing problems to determine the existence, uniqueness and stability of solutions.
- The benefits of using linear algebra in solving problems.
- The relationship between complex exponential functions and trigonometric functions.
- The significance of computing eigenvalues and eigenvectors of a matrix.

**Learning Outcomes:** On successful completion of this unit, students should be able to:

- Review and fortify mastery of integration techniques for solving order differential equations.
- Apply Picard’s Theorem to determine the existence and uniqueness of solutions of initial value problems.
- Compute solutions of inhomogeneous problems using the methods of undetermined coefficients and variation of parameters.
- Model, analyze and interpret oscillators, such as pendulums and inductor-capacitor circuits.
- Perform Gauss-Jordan Elimination to solve linear systems, compute inverses to matrices and compute determinants of matrices.
- Determine a basis for a vector space and the dimension of the subspace.
- Compute the eigenvalues and eigenvectors of a matrix.
- Identify equilibrium points of an autonomous system and determine their linear stability.
Textbook: *Differential Equations and Linear Algebra*, 2nd edition, by Farlow, Hall, McDill and West. We will cover most of Chapters 1-7.

Course webpage: The Math 24 website is part of the UCMCROPS course management system. It is available automatically to all students enrolled in this class. The website contains the course calendar, announcements, and email list. We will use this site to distribute course materials and make email announcements.

Discussion sessions: Discussion sessions will meet for two hours each week, where you will develop and practice your problem-solving skills by working with your classmates to solve challenging problems. Your discussion section grade will be based on your attendance, participation, and quiz scores. *Your participation in your assigned discussion sections is necessary and will be graded (see below).* If you would like to change the discussion section to which you are assigned you must do so in advance by approaching your Instructor and TAs.

Discussion sections will be centered around worksheets with problems considerably more challenging than homework problems. Worksheets will be posted on the course web page under Resources before the discussion sessions. It is your responsibility to print a copy of the worksheet before attending to your discussion section.

Grade determination: Your final grade in the course will be based on a total of 700 points as follows: Homework assignments: 100 points. Discussion session attendance, participation and quizzes: 100 points. Three mid-term exams: 100 points each, covering the material between the exams. Final exam: 200 points, covering the entire course material.

If you obtain 90% of the total points you will definitely receive an A in the course. If you obtain less than 55% of the total points you will definitely receive an F. For everything in between, letter grades will be given using the approximate scheme: A: 90–100%, B: 80–90%, C: 70–80%, D: 60–70%. Please be aware that you need a C– or better in order to proceed to Advanced Mathematical Methods as well as advanced Engineering courses.

Exams: There will be three unit (mid-term) exams and a comprehensive final. The lecture preceding every mid-term will serve as a review session. The mid-term exams will take place during the time allotted to the lecture as follows:

**Exam 1:** Monday, February 23, 12:00 – 12:50 pm (COB 120)

**Exam 2:** Friday, March 20, 12:00 – 12:50 pm (COB 120)

**Exam 3:** Monday, April 27, 12:00 – 12:50 pm (COB 120)

**Final exam:** Friday, May 15, 11:30 – 2:30 pm (location TBA)

For your convenience, MATH 24 exams from previous semesters are available on the Applied Math website.

There will be no make-up exams or early exams! If you are sick during a unit exam please bring a note from your doctor verifying your illness. Your course grade will then be determined by the rest of your course work. Please bring your student ID to each exam. A special needs room for people with documented disabilities will be provided for each exam. Speak to your lecturer for more information. Crib sheet and Calculators are not allowed on exams.

Quizzes: 10-minute quizzes will be given frequently at the beginning of the discussion sessions. They will be graded only for those students participating in their assigned discussion section. Notebooks, books, calculators and crib sheets will not be allowed on quizzes. The quiz will typically include one problem taken from one of homework problems due during the previous week. To accommodate for unexpected emergencies or illness, your lowest discussion section score will be dropped when determining your final grade.

Homework: Homework problems will be assigned per lecture and typically collected at the beginning of each Monday lecture. Late homework will not be accepted or graded. Your lowest two homework scores will be dropped when determining your final grade.

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1. [http://ucmcrops.ucmerced.edu](http://ucmcrops.ucmerced.edu)
2. [http://appliedmath.ucmerced.edu/oldexams.html](http://appliedmath.ucmerced.edu/oldexams.html)
Typically, three homework problems will be chosen to be graded in detail based on correctness and presentation. The rest of the problems will be graded based on submission, completion and presentation. Graded homework will be returned during the next discussion section. It is your responsibility to pickup your graded homework assignments. **Homework assignments that are not picked up will be shredded one month after the return date.**

You are encouraged to work in groups. However, **all work turned in must be your own.** At the end of your written homework you must identify explicitly all individuals with whom you worked on each problem. You must also **list explicitly any outside sources employed** (e.g. websites, Mathematica, book other than the textbook, etc.) for each problem you solve. This does not mean that you are allowed to copy a solution should you find it posted elsewhere (see Academic integrity below).

Homework must be presented according to the guidelines at the end of this document. You must staple your homework and clearly write your full name and discussion section number (or time) on it. Only the first page of an **unstapled** multiple-page homework will be graded.

**Homework Grading Rubric:** Homework problems will be graded using the following general rubric.

- 5–excellent: The work indicated clear and complete understanding of the material and methods.
- 4–good: The student got the basic idea right, but messed up on one thing.
- 3–fair: The student got it partially, but missed something important. Part of the answer may look like it was done more by rote rather than by true understanding.
- 2–poor: understanding: Everything is done by rote, but the work implies that the student does not understand what he or she is doing.
- 1–no understanding: The student may have jotted down some appropriate formulas and diagrams, but did not know what to do with them.
- 0: Wrote hardly anything or blatantly wrong or incomplete answer.

**Electronic Devices:** All portable electronic devices (e.g. cell phones, pagers and laptops) must be turned off and put away during exams, lectures, and discussion sections. Calculators may be used in lectures and discussion sections, but not in exams. If permitted by your Instructor or TA, a laptop may be used during the lecture or discussion sessions for the sole purpose of taking notes and as a calculator.

We recommend that you use a calculator (graphing or otherwise) and/or other computational tools (e.g. Mathematica, Maple, Matlab, Octave, etc.) to aid in your completion of homework assignments. A free alternative, which is well suited for this course, is the Mathematical Visualization Toolkit (MVT)\(^3\). You may need some calculation tools for certain homework and discussion section problems, but not on exams.

**Dropping the course:** You may drop this course without paying a fee and without further approval before **5:00 pm Friday, Feb. 13.** Dropping the course after this time will require a petition approved and signed by the Instructor and your cognizant Dean, and a fee will be assessed. Please see the Instructor and consult the UC Merced General Catalog for more details.

**Green books:** Each student is required to purchase **four** green (or blue) books and give them to the TA by the beginning of the discussion section on Tuesday, January 30. Green books are preferred to blue books, because they are made from recycled material. These will be distributed during the exams, so please do not write anything (not even your name) on the blue books.

**Extra help:** You are encouraged to get extra help whenever you need it. Instructor and TA office hours are listed above. Other helpful items are posted on the UCMCROPS page under Resources. You are welcome to send questions to the Instructor and TAs via e-mail at any time. **Free Tutoring** is available through the Student Advising and Learning Center\(^4\). The Center also provides Student Success Workshops.

**Learning tips:** See below.

**Special accommodations:** If you qualify for accommodations because of a disability, please submit a letter from Disability Services to the lecturer in a timely manner so that your needs may be addressed. Student

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\(^3\) Available at [http://amath.colorado.edu/java/index.php](http://amath.colorado.edu/java/index.php)

\(^4\) [http://learning.ucmerced.edu/](http://learning.ucmerced.edu/)
Affairs determines accommodations based on documented disabilities.

The Instructor will make every effort to accommodate all students who, because of religious obligations, have conflicts with scheduled exams, assignments, or required attendance. Please speak with me during the first week of classes regarding any potential academic adjustments or accommodations that may arise due to religious beliefs during this term.

**Academic integrity:** Academic integrity is the foundation of an academic community and without it none of the educational or research goals of the university can be achieved. All members of the university community are responsible for its academic integrity. Existing policies forbid cheating on examinations, plagiarism and other forms of academic dishonesty. The current policies for UC Merced are described in the Academic Honesty Policy. Examples of academic dishonesty include:

- receiving or providing unauthorized assistance on examinations
- using unauthorized materials during an examination
- plagiarism - using materials from sources without citations
- altering an exam and submitting it for re-grading
- fabricating data or references
- using false excuses to obtain extensions of time or to skip coursework

The ultimate success of a code of academic conduct depends largely on the degree to which the students fulfill their responsibilities towards academic integrity. These responsibilities include:

- Be honest at all times.
- Act fairly toward others. For example, do not disrupt or seek an unfair advantage over others by cheating, or by talking or allowing eyes to wander during exams.
- Take group as well as individual responsibility for honorable behavior. Collectively, as well as individually, make every effort to prevent and avoid academic misconduct, and report acts of misconduct which you witness.
- Do not submit the same work in more than one class. Unless otherwise specified by the instructor, all work submitted to fulfill course requirements must be work done by the student specifically for that course. This means that work submitted for one course cannot be used to satisfy requirements of another course unless the student obtains permission from the instructor.
- Unless permitted by the instructor, do not work with others on graded coursework, including in class and take-home tests, papers, or homework assignments. When an instructor specifies that students may collaborate on work required for a course, the extent of the collaboration must not exceed the limits set by the instructor.
- Know what plagiarism is and take steps to avoid it. When using the words or ideas of another, even if paraphrased in your own words, you must cite your source. Students who are confused about whether a particular act constitutes plagiarism should consult the instructor who gave the assignment.
- Know the rules – ignorance is no defense. Those who violate campus rules regarding academic misconduct are subject to disciplinary sanctions, including suspension and dismissal.

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5 See under Student Judicial Affairs at [http://studentlife.ucmerced.edu](http://studentlife.ucmerced.edu)
Homework preparation requirements & guidelines

Learning mathematics involves learning how to communicate your ideas effectively. As a student, much of this communication will be in the form of homework. Therefore, so that we may provide you with meaningful and worthwhile feedback, it is important that you put your homework in an easy to read, easy to navigate format. After all, how you present your work should enhance the ideas you are trying to communicate, not impede them.

It is good practice to first work out the solutions to homework problems on scratch paper, and to then neatly write up your solutions. This will help you to turn in a clean finished product.

The following are the requirements for submitting homework in Math 24:

- Your handwriting should be legible.
- Homework with multiple pages must be stapled in the upper left-hand corner.
- In the upper right-hand corner you must write (in this order):
  - First and Last Name
  - “Math 24”, followed by your Discussion Section Number (or time).
  - Homework Set Number
  - Due Date of the Homework
- Problems should be clearly labeled and numbered on the left-hand side of the page. There should also be a visible separation between problems.
- Problems should be written in the order they are assigned.
- All graphs should have clearly labeled axes.
- At the end of your written homework you must explicitly identify all individuals with whom you worked. You must also explicitly list any outside sources employed (websites, Mathematica, book other than course text, etc.).

Tips for Success

Everything that we will do in this class is to help you learn mathematics, but you need to take control, ownership and responsibility of your academic career.

Many students consider the subject of differential equations to be an abstract and difficult one. Do not let this mislead you! Differential equations are the language in which the laws of Nature are expressed. They are one of the primary reasons for learning calculus as a whole, and are largely responsible for the development of Science and Engineering. Remember that this course will enrich your intellectual and mathematical skills that are essential on your way to becoming a successful scientist or engineer. While it is true that this course will require a lot of work on your part, do not let this deter or discourage you. The required calculus skills are on par with those obtained in Calculus II, but in Math 24 you will encounter new ideas that, in many cases, cannot be summed up into formulas.

Problem solving. The goal of this course is to help you learn differential equations and linear algebra as well as you can. Learning differential equations, like any branch of calculus, means doing calculus. In much the same way as pianist must practice music notes and a soccer player must practice kicks, a student in Math 24 needs to practice solving problems. Remember: there is no “royal road” to differential equations.

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6 http://www.math.hmc.edu/teaching/homework
Even kings and queens need to practice the same as everyone else, if they are to learn differential equations. The same ideas apply to linear algebra.

To succeed in this course, you need to learn (1) how to solve a differential equation/linear algebra problem and (2) why the math works the way it does. To learn these two things, you need to gain experience by solving lots of problems. Along these lines, allow me to suggest the following tips for success (in no particular order).

▷ Manage your time wisely! Plan to spend at least two hours outside of each lecture and discussion section working with the material.
   - Before Lecture: Read (at least scan) the day’s section. Work through the example problems in that section and identify in them what you know already and what is new and different.
   - After Lecture: Review the day’s textbook section and lecture notes. Go over the example problems done in class to warm up. Ask yourself, “What is the big picture?” Try to answer that question as best as you can. Then start the homework problems.

▷ Be mindful of the time it takes to complete a problem. Speed is not the most important factor in your success in this course. However, there is a time limit to every homework assignment and exam. So, to some extent, you are graded based on your ability to solve problems in a timely manner. Practice through solving lots of problems is the key.

▷ Be engaged in the class and discussion sections. Attend all lecture and discussion sections, and ask questions when you have them – don’t wait until later.

▷ As you practice solving problems, always try to understand the “why” behind the methods you use. Exams will be written to test your understanding of the methods, not your ability to follow a “recipe” for solving a particular problem.

▷ Homework will consist of odd and even numbered problems. For even numbered problems, there are no solutions in the book. If you are stuck on a problem, try the odd-numbered problems on either side, for which the solution is in the back of the book.

▷ Utilize your instructor’s and teaching assistant’s office hours to aid in both completion of homework and to understand topics that are unclear.

Attending class. Consider the following question. How do I learn mathematics best during class? Next, consider the following possible answers.

- I learn best by listening to a lecture. If so, consider not taking notes during class, but simply listening. Read the corresponding section in the textbook or get the notes from a classmate.

- I learn best by writing notes or manipulating the subject matter with my own hands. If so, consider recopying your notes after each lecture and summarizing your notes for the exams.

- I learn best by reading a book. If so, consider reading ahead in your textbook so that lectures reinforce your learning rather than confuse it.

- I learn best by seeing graphs or charts. If so, create diagrams and visual cues while taking notes.

It is very likely that you learn mathematics during class by a combination of the ways listed above. By spending the time to understand how you learn mathematics, you can develop your own strategy for succeeding in this and any other mathematics courses.