LINEAR ALGEBRA AND DIFFERENTIAL EQUATIONS  
MATH 320 LECTURE 001 (3 CREDITS)  
SPRING 2020

Official Course Description: Introduction to linear algebra, including matrices, linear transformations, eigenvalues and eigenvectors. Linear systems of differential equations. Numerical aspects of linear problems. Prospective math majors should instead consider MATH 341 for a proof based introductory linear algebra course. Enroll Info: None

REQUISITES: MATH 222 or 276 or graduate/professional standing

Course Designations and Attributes:
- Breadth - Natural Science
- Level - Advanced
- L&S Credit - Counts as Liberal Arts and Science credit in L&S

How Credit Hours are Met: Meets for two 75-minute class periods and one 50-minute discussion period each week over the spring semester and carries the expectation that students work on course learning activities (problem sets & studying) for about 3 hours out of classroom for every class period. The syllabus includes additional information about meeting times and expectations for student work.

Instructional Mode: Face-to-Face

Meeting Day, Time & Location:

<table>
<thead>
<tr>
<th>MATH 320 MEETING DAYS</th>
<th>TIME</th>
<th>ROOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECTURE 001: TR</td>
<td>04:00 – 05:15 AM</td>
<td>Van Vleck: B239</td>
</tr>
<tr>
<td>DISCUSSION 301: M</td>
<td>08:50 – 09:40 PM</td>
<td>Van Vleck: B119</td>
</tr>
<tr>
<td>DISCUSSION 302: M</td>
<td>08:50 – 09:40 PM</td>
<td>Van Vleck: B231</td>
</tr>
<tr>
<td>DISCUSSION 303: W</td>
<td>11:00 – 11:50 PM</td>
<td>Chamberlin: 2116</td>
</tr>
<tr>
<td>DISCUSSION 305: M</td>
<td>11:00 – 11:50 PM</td>
<td>Van Vleck: B135</td>
</tr>
</tbody>
</table>
INSTRUCTOR AND TEACHING ASSISTANTS:

LECTURE: Gary Schroeder
• OFFICE: B127 VV
• OFFICE HOURS: TR: 05:15 – 6:15 PM (except Exam Thursdays)
• EMAIL: ghschroe@wisc.edu

TA: Jiwoong Jang
• DISCUSSIONS: 301 & 303
• OFFICE: 101-14 Van Vleck
• OFFICE HOURS: M, 9:50 – 11:50 AM
Email: jjang57@math.wisc.edu

TA: Enkhzaya "Eza" Enkstaivan
• DISCUSSIONS: 302 & 305
• OFFICE: 716 Van Vleck
• OFFICE HOURS: F, 11:00 AM – 01:00 PM
Email: enkhtaivan@wisc.edu

COURSE LEARNING OUTCOMES: AT THE END OF THIS COURSE STUDENTS SHOULD BE ABLE TO:

1. Recall and state the formal definitions, properties, and theorems associated to elementary linear algebra and ordinary differential equations (e.g. existence & uniqueness theorems for first-order ODEs, eigenvalues & eigenvectors, etc.).

2. Verify if a mathematical object has a given property used in elementary linear algebra and differential equations (e.g., that a matrix is invertible, a subset is a vector subspace, a vector is an eigenvector, etc.).

3. Check the premises of theorems used in elementary linear algebra in order to apply their conclusions (e.g., that a given matrix has a zero determinant and therefore cannot be inverted).

4. Resolve algebraic statements related to elementary linear algebra through appropriate computations and compute solutions to elementary systems of ordinary differential equations.

5. Express informal mathematical arguments in English using appropriate mathematical terminology and notation.

TEXTBOOK: Differential Equations and Linear Algebra, Fourth Ed
• Author: C. Henry Edwards, David E. Penney & David T. Calvis
• Publisher: Pearson
• ISBN: 978-0-13-449718-1
**Grading:** The course-grade is based on the cumulative points received on the two 100 point midterm exams and the 150 point final exam. The maximum course-points is 350. Your cumulative-points will appear on Canvas in “Grades”.

The table below indicates the lower cumulative-point cut-off for each letter-grade, after each midterm and after the final exam.

<table>
<thead>
<tr>
<th>LETTER GRADE</th>
<th>LOWER GRADE CUTOFF PERCENTAGE</th>
<th>AFTER EXAM 1 - MAXIMUM CUMMULATIVE POINTS = 100 (R, 2/20)</th>
<th>AFTER EXAM 2 - MAXIMUM CUMMULATIVE POINTS = 200 (R, 4/02)</th>
<th>FINAL EXAM - MAXIMUM COURSE POINTS = 350 (F, 5/8 @ 10:05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>84 %</td>
<td>84</td>
<td>168</td>
<td>294</td>
</tr>
<tr>
<td>AB</td>
<td>78 %</td>
<td>78</td>
<td>156</td>
<td>273</td>
</tr>
<tr>
<td>B</td>
<td>72 %</td>
<td>72</td>
<td>144</td>
<td>252</td>
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<tr>
<td>BC</td>
<td>66 %</td>
<td>66</td>
<td>132</td>
<td>231</td>
</tr>
<tr>
<td>C</td>
<td>60 %</td>
<td>60</td>
<td>120</td>
<td>210</td>
</tr>
<tr>
<td>D</td>
<td>48 %</td>
<td>48</td>
<td>96</td>
<td>168</td>
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**Possible Curve:** A curve may be applied to Total-Points after the Final Exam only if there are fewer than 25% of grades of AB or above OR more than 5% F’s.

**Components of Your Course Grade:**

**Exams (General):**

- **Exam Structure:** Exams are primarily made up of problems similar to those on assigned HW. Exams occasionally include questions that test understanding of definitions & theorem statements.
- **Seating During Exams:** Sit every other seat.
- **One Note Page is Allowed:** You may bring only one standard (8.5 X 11) page with only verbal descriptions and formulas (both-sides is ok), but only one page! Your note-page cannot include parts of problem solutions. Print your name on your note-page and submit it tucked into your completed exam.
  
  *Note:* If you have two pages of notes, one will be removed by an instructor.
- **Not Allowed During Exams:** Textbooks, notes (other than the allowed note-page), laptops and phones must be stored out of view and cannot be referenced during exams.
- **Exam Dates:** Exam dates appear on the semester class-schedule at the end of this syllabus and on the weekly announcements on Canvas.
- **Make-up Exams:** Make-ups are given only when there’s a valid reason. Valid reasons are typically illness or family emergencies. When possible, make-up arrangements should be made in advance. It is in your overall interest to make-up missed exams in a timely fashion.
- **No Dropped Exam Grades or Exam Retakes:** There are no dropped exam grades, nor are there retakes of previously taken examinations.
Midterm Exams:

- **Points**: There are two In-Class 75-minute, 100-point midterm exams.
- **Exam Dates**: Thursdays 2/20 & 4/02.
- **Focus of Midterm Exams**: Midterm exams focus on material covered since the previous midterm.
- **Return and Review of Midterm Exams**: Exams are returned and reviewed (as necessary) in the Discussion following the exam. Individual questions pertaining to grading are entertained for two weeks after the in-class exam date. After two weeks, midterm exam grades are final and cannot be changed.

Final Exam:

- **Points**: The Final Exam is worth 150-points
- **Date & Time**: The Final Exam is on Friday 5/08, @ 10:05 – 12:05 pm.
- **Focus of the Final Exam**: The Final Exam is cumulative. Details will be discussed after the 2nd Midterm.

Home-Work Problems: HW is assigned, but not graded. Assigned HW problems appear at the end of each text-section and are the primary source of exam problems. HW problems are chosen to provide familiarity with ideas in a text-section. Answers to many assigned HW problems appear in the back of the text (see p677). Modified HW problems make-up the majority of exam points. From time to time, you may need to select more problems on your own to solidify your understanding of a concept.

Understanding assigned HW problems is the major emphasis in Discussion sections.

As you prepare for an exam, be aware that: To score points on exam problems or other questions, you have to **both**:

1. Know how to solve the problem - or - be familiar with the relevant material and
2. Communicate to the grader, on the exam paper, that you know how to solve the problem or that you are familiar with the material.

Discussion Section Primary Focus: To answer student questions on the homework assigned by the lecturer and on theory relating to applications.

During Lecture: Laptops, phones and similar-devices are to be stored during class.

Class Etiquette: Please arrive to class prior to its start and please wait until the class is over before leaving. Late arrivals and early exits are distracting to both other students and the instructor.
# Class Schedule & Homework

<table>
<thead>
<tr>
<th>Week</th>
<th>Tuesday Lecture</th>
<th>Thursday Lecture</th>
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| 1    | 1/21 – First Class Day  
Section 1.1: Differential Equations & Math Models.  
HW: 7, 15, 17, 33  
Section 1.3: Slope Fields & Solution Curves  
HW: 2, 6, 13, 14, 20, 25 | 1/23  
Section 1.4: Separable Equations: y’ = g(x)/h(y)  
HW: 3, 23, 29  
Section 1.5: Linear First-Order Equations  
HW: 3, 21, 22, 31, 33 |
| 2    | 1/28  
Section 2.1: Population Models  
HW: 1, 9, 11, 13, 23, 29 | 1/30  
Section 2.2: Equilibrium Solutions & Stability  
HW: 1, 3, 14, 23, 26 |
| 3    | 2/04  
Section 3.2: Matrices & Gaussian Elimination  
HW: 1, 5, 11, 13, 15, 27 - 29  
Section 3.3: Reduced Row Echelon Matrices  
HW: 3, 7, 17 | 2/06  
Section 3.4: Matrix Operations  
HW: 3, 6, 10, 13, 17, 27 |
| 4    | 2/11  
Section 3.5: Inverses of Matrices  
HW: 9, 11, 25, 30, 41 | 2/13  
Section 3.6: Determinants  
HW: 3, 5, 7, 11, 17, 27, 33, 47, 53 |
| 5    | 2/18 – Catch-up & Review | 2/20 – Exam 1: In-Class (Chapters 1 – 3) |
| 6    | 2/25  
Section 4.2: The Vector Space R^n & Subspaces  
HW: 1, 11, 13, 15, 18, 19, 24  
Section 4.3: Linear Combination & Independence of Vectors  
HW: 2, 5, 11, 14, 19, 21, 28, 29 | 2/27  
Section 4.4: Basis & Dimension for Vector Spaces  
HW: 3, 4, 8, 9, 15, 19 |
| 7    | 3/03  
Section 4.5: Row & Column Spaces  
HW: 3, 8, 13, 19, 23, 25  
Section 4.6: Orthogonal Vectors in R^n  
HW: 1, 7, 11, 21, 23, 24 | 3/05  
Section 5.2: General Solutions of Linear Equations  
HW: 4, 9, 13, 19, 21, 23, 25, 26, 30 |
| 8    | 3/10  
Section 5.3: Homogeneous Equations with Constant Coefficients  
HW: 1, 3, 5, 9, 14, 21, 23, 27, 33, 39, 55 | 3/12  
Section 5.5: Nonhomogeneous Equations & Underdetermined Coefficients  
HW: 1 – 4, 7, 9, 11, 31 – 33, 44, 47, 49 |
|      | Spring Break: 3 / 14 – 3 / 22 | |
| 9    | 3/24  
Section 6.1: Introduction to Eigenvalues  
HW: 13, 19, 23, 25, 27, 36, 37, 38 | 3/26  
Section 6.2: Diagonalization of Matrices  
HW: 13, 15, 21, 27, 29 – 32 |
| 10   | 3/31 – Catch-up & Review | 4/02 – Exam 2: In-Class (Chapters 4 – 6) |
| 11   | 4/07  
Section 7.1: First Order Systems & Applications  
HW: 1, 5, 7, 9, 21, 22, 23 | 4/09  
Section 7.2: Matrices & Linear Systems  
HW: 1, 3, 5, 7, 9, 15, 21, 24, 29, 33, 34 |
| 12   | 4/14  
Section 7.3: The Eigenvalue Method for Linear Systems  
HW: 17, 23, 25, 26, 27 | 4/16  
Section 7.5: Second Order Systems & Mechanical Applications  
HW: 1, 3, 9, 14 |
| 13   | 4/21  
Section 8.1: Matrix Exponentials & Linear Systems  
HW: 1, 3, 7, 9, 23, 27, 37 | 4/23  
Section 8.2: Nonhomogeneous Linear Systems  
HW: 1, 3, 15, 16 |
| 14   | 4/28 – Catch-up & Review | 4/30 – Last Class Day – Final Exam Review |

**Final Exam:** Friday 5/08, 10:05 – 12:05
RULES, RIGHTS & RESPONSIBILITIES: To see the Guide’s Rules, Rights and Responsibilities information, refer to http://guide.wisc.edu/undergraduate/#rulesrightsandresponsibilitiesText.

ACADEMIC INTEGRITY: By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison’s community of scholars in which everyone’s academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES
McBurney Disability Resource Center syllabus statement: “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.” http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION
Institutional statement on diversity: “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.” https://diversity.wisc.edu/