The University of Southern Mississippi **Department of Mathematics**

MAT 326 Linear Algebra I

Bulletin Description: Corequisite: MAT 168 or 179. Vector spaces, systems of linear equations, linear transformations, matrices, inner products.

Text *Matrix Analysis and Applied Linear Algebra*, Carl D. Myer, SIAM, (2000).

References: The following is a partial list of supplemental reading:

1. *Introduction to Matrices and Linear Transformations*, Daniel T. Finkbeiner II, W.H. Freeman, 3rd ed. (1978).
2. *The Maple Handbook*, Darren Redfern, Springer-Verlag, (1993).
3. *Matrix Computation for Engineers and Scientists*, Alan Jennings, Wiley, (1977).
4. *Elementary Linear Algebra 8E*, Howard Anton, Prentice Hall, (2000).

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Goals: To provide an introduction to the basic structure of linear vector spaces and an understanding of the properties and theory of linear transformations. The intent is to introduce theory and practice supported by a problem solving approach with foundations in the the solution of linear systems of equations and matrix operations. The relationship between a linear map, its matrix representations and the theoretical developments needed to categorize its fundamental properties are central to the course.

Topics: The intent is to cover chapters 1–7 of the text. Weekly assignments are posted at `http://www.math.usm.edu/kolibal`, and problems are reviewed in class. Areas of emphasis include:

1. Solutions of linear equations and matrix operations, row operations, reduction and row equivalence. Fundamentals of matrix algebra.
2. Determinants, including alternating multi-linear maps, permutations and cofactor expansion.
3. Vector geometry and fundamentals of vector spaces, including linear independence, bases and dimension and coordinates with respect to a basis. Rank and nullity.
4. Inner product spaces, orthonormal bases, Gram-Schmidt orthogonalization, least squares approximation, and orthogonal matrices.
5. Relating matrices to linear transformations and developing the properties of linear operators, coordinate transformations and diagonalizability.
6. Norms and inner products; least squares and orthogonal projection.
7. Eigenvalues and eigenvectors.

Assessment: The material is presented in a manner which ties these developments to elementary applications of interest to the student, including computer error correction coding (Hamming matrices), least squares approximation, difference equations, boundary conditions for hyperbolic PDEs, and iterated functions. Awareness of computational issues associated with large linear systems is developed. Involvement with symbolic algebra using `Maple` is stressed at all levels as a tool to facilitate the study of linear algebra.

The course assessment is based on extensive midterm assignment (stressing analysis and theory) 50%, and a comprehensive in-class examination stressing proficiency 50%. Details of the grading policy are available online at the web site.

Course Assessment Policy

Contact

If there are any questions or concerns about grading policy pertaining to this course or its application, please mail inquiries to Joseph.Kolibal@usm.edu. If you need to see me about a particular problem, please schedule an appointment.

Basis of the Class Evaluation

Each student is assessed based on a cumulative point score from 0 to 100. The score is based on examination papers, bonus points and on class participation (problem solving). The algorithm is explained under the topic Scoring and Course Grades. Graduate students have an additional project grade in mixed undergraduate/graduate classes which is part of the assessment and some additional rules and policies apply.

Examination Papers

Typically in a lower level class (100 - 200 level) there are at least four examinations, one of which consists of a midterm paper, and one a comprehensive examination. In an upper level class (300 and above) there is only the midterm paper and a comprehensive examination paper. Depending on the syllabus, in a graduate level class (500 and above) additional projects are assigned. For pre-calculus classes there is typically one exam at the end of each chapter.

The midterm paper is intended to provide an extensive assessment of the student's ability to work with the material and to reason in an un-timed environment. The midterm paper is always a lengthy paper in upper level classes. and the student is usually given one week to complete the midterm paper. Because of this, the level and quality of work is expected to be high. In introductory classes (e.g., MAT-101), the midterm is typically a comprehensive, an in-class exam covering the material up to the date of the exam. The final exam is a comprehensive evaluation that covers all material which is discussed in the course and is usually given in class toward the end of term. Other exams are specific to topics or chapters, with an emphasis on the material covered in those chapters.

All in class examinations are closed book, no notes, unless otherwise specified. The exception to this rule is for introductory classes (such as MAT-101). The questions are designed to test reasoning and the ability to work with the material. Each paper or exam is worth 100 points. The course grade is based on the average score obtained on all examination papers, plus bonus points which are earned for solving more difficult problems less points deducted for failure to participate in class.

Bonus Problems

Bonus problems are typically given as extra problems on examination papers, or else are given during the course of the semester, to be turned in at the required time. Bonus problems are more difficult and challenging problems which are available for students to gain experience beyond the requirements of the course. These problems usually have point values from 1 to 10. Students are not required to do these problems, but it is to the student's benefit to attempt them since they are counted after the examination results are averaged.

In classes with a mixed graduate and undergraduate component the bonus points are worth only half as much for the graduate students taking the course.

Class Participation (Assignments and Homework)

There is no credit given for homework assignments in any class, except an introductory class (e.g., MAT-101), however since examination papers are based on the material and problems which are to be found in the homework assignments, it is beneficial to attempt all of the problems. In an introductory class, homework assignments will be handed in each week for credit (typically 1/2 bonus point, if there was a substantial attempt to obtain the required solutions, and 0 points otherwise). All students are required to be able to solve or attempt to solve homework problems in class. Failure to participate in this activity will result in the loss of up to 5 points from your final score.

The use of Technology

The use of technology is strongly encouraged, particularly in classes where there there a strong linkage between computers and mathematics, e.g., in numerical or computational classes, or in those where symbolic algebraic computation is required. In contrast, the use of calculators or other technology which serves to mask deficiencies in being able to work with arithmetic or algebra is strongly discouraged. Often students use technology to avoid working with concepts and abstraction and this is also discouraged. Thus the correct use of technology, and policies regarding its use are set strictly for each class, and each examination.

Scoring and Course Grades

The class grade is based on the student's earned point score for the semester. This earned point score is computed using the average of all points earned on papers to which the bonus points are then added. From this score, up to 5 points may be lost for failure to participate in class work. Determination of Class Grade The class grade is assigned based on

- 90 – 100 : A
- 80 – 90 : B
- 70 – 80 : C
- 60 – 70 : D
- 00 – 60 : F

Grades which fall on a grade boundary, for example a score of 90, are decided at the discretion of the instructor based on the participation of the student in class.

Further Considerations and Rules

Late Papers

Any material handed in late without having obtained prior approval or without having a valid university excused absence (e.g., a signed medical excuse) results in a 50% factor being applied to the students score on that paper. Material handed in over one week late without prior approval is not accepted, resulting in a score of 0 for that paper. Please note:

> *It is the student's responsibility to contact the instructor concerning any scheduling conflicts which may result in late papers or result in a failure to attend scheduled in class exam.*

Considerations for the Student

Because of the importance attached to solving bonus problems and because no examination results are curved or normalized, it is strongly emphasized to the student that they attempt as many bonus problems as possible. These provide a mechanism for improving performance; however, unlike 'curving' exam results,

they require that the students take the initiative to improve their scores. The examinations are structured so that without attempting to solve any of the bonus problems the average grade that can be expected by a student is a high C or low B. If there is a need for better grade, it is important to attempt bonus problems.

In a lower level class the first exam will always be before the drop date. This allows students to assess without penalty whether they desire to continue with the class. In an upper level class, self-assessment is the responsibility of the student.

Plagiarism/Cheating Statement

Students are expected to adhere to the highest standards of academic honesty as outlined in the USM Student Handbook. Any information that is copied from another source must be noted as such in student materials. Page number or Internet reference must appear in the text ad full bibliographic references must appear in the reference section of the paper/assignment. Sources must be in quotes, and include author(s), year of publication or other reference notes as required by the college department format (e.g. APA, Chicago). Other forms of academic dishonesty include, but are not limited to buying papers, copying paragraphs/pages of text/whole papers off the Internet, copying another student's answers, etc. Academic dishonesty will result in the grade of a "0" on the assignment and/or in the course and/or the student may be reported to the Vice President for Academic Affairs for further action.

Typical schedule of Assignments, Fall 2005

Week 16
Mon, Dec 6:
Review.
Wed, Dec 8:
Exam 2.
Fri, Dec 10:
Exam 2 discussion and review.

Week 15
Mon, Nov 29:
Read Chapter 7.1.
Wed, Dec 1:
Sec.7.1. p.500: 1-3.
Fri, Dec 3:
Read Chapter 7.2.
Sec.7.1. p.520: 1, 3.

Week 14
Mon, Nov 22:
Read Chapter 5.6.
Sec.5.6. p.335: 1-3,4(a)
Wed, Nov 14:
Read Chapter 7.1.
Fri, Nov 26:
Thanksgiving Holiday

Week 13
Mon, Nov 15:
Read Chapter 5.4
Wed, Nov 17:
Read Chapter 5.5
Sec.5.4. p.303: 1-6.
Fri, Nov 19:
Read Chapter 5.5 (continued).
Sec.5.5. p.303: 1-2.

Week 12
Mon, Nov 8:
Sec.5.1. p.276: 1 - 5.
Read Chapter 5.2.
Wed, Nov 10:
Read Chapter 5.2, 5.3.
Fri, Nov 12:
Sec.5.1. p.276: 6.
Sec.5.2. p.285: 1, 2,
Sec.5.3. p.292: 1, 2.

Week 11
Mon, Nov 1:
Midterm review.
Wed, Nov 3:
Sec.4.7. p.248: 4-8
Sec.4.8. p.257: 1,2,3.
Fri, Nov 5:
Chapter 5.1.
Sec.4.8. p.257: 4, 5, 6. 9.

Week 10
Mon, Oct 25:
Read Chapter 4.7.
Wed, Oct 27:
No class, midterm exam.
Fri, Oct 29 :
Read Chapter 4.8.
Sec.4.7. p.248: 1-4
Midterm due

Week 9
Mon, Oct 18:
No class, midterm break.
Wed, Oct 20:
Read Chapter 4.4
Midterm handed out, due Fri, Oct. 29.
Fri, Oct 22:
Sec.4.4. p.206: 1,2,3.

Week 8
Mon, Oct 11:
Read Chapter 4.2.
Wed, Oct 13:
Read Chapter 4.3
Fri, Oct 15:
Sec.4.2. p.179: 1, 3, 4, 6.
Sec.4.3. p.190: 1.

Week 7
Mon, Oct 4:
Chapter 6.2 Determinants (continued).
Sec.6.2, p.482: 19, 24.
Wed, Oct 6:
Read Chapter 4.
Fri, Oct 8:
Sec.4.1, p.168: 1-4, 6, 10, 11.

Week 6
Mon, Sep 27:
Quiz
Wed, Wed Sep 29:
Sec.6.1, p.472: 1, 3, 5, 6.
Fri, Oct 1:
Sec.6.2, p.482: 1, 2, 3, 5.

Week 5
Mon, Sep 20:
Read Chapter 3.9.
Wed, Sep 22:
Sec.3.6, p.112: 1,3,4,5,7.
Sec.3.7, p.122: 1-8.
Fri, Sep 24:
Chapter 6. Determinants.
Read Sec. 6.1.
Sec.3.9, p.140: 1-4.

Week 4
Mon, Sep 13:
Read Chapter 3.6-3.7.
Wed, Sep 15:
Classes Canceled
Fri, Sep 17:
Classes Canceled

Week 3
Mon, Sep 6:
No Class, Holiday
Wed, Sep 8:
Read Chapter 3.3-3.4.
Sec.3.3, p.92: 1, 2, 4.
Sec.3.4, p.94: 1.
Fri, Sep 10:
Read Chapter 3.5.
Sec.3.5, p.102: 1-6, 8.

Week 2
Mon, Aug 30:
Assignment:
Read Chapter 2-2-2.3
Sec.1.3, p.17: 1-3.
Sec.2.1, p.46: 1-3, 6.
Sec.2.2, p.51: 1a, 2.
Wed, Sep 1:
Read Chapter 2.4-2.5.
Sec.2.2, p.51: 1a, 2.
Sec.2.3, p.55: 1, 2, 3, 5.
Fri, Sep 3:
Read Chapter 3, Chapter 3.1-3.2.
Sec.2.4, p.62: 1, 2, 3,8.
Sec.2.5, p.70: 1, 4, 5.
Sec.3.2, p.88: 1-7.

Week 1
Mon Aug 23:
Read Chapter 1.1-1.3, 1.6, Myer.
Wed, Aug 25:
Read Chapter 2.1-2.2.
Wed, Aug 25:
Read Chapter 2, Chapter 2.3-2.4.
Sec.1.2, p.12: 1, 2, 3, 6, 8, 10.