Course specification

MATH 224, *Linear Algebra 2*, Spring 2024

Laurence Barker, Bilkent University. Version: 23 February 2024.

Course Aims: To aquire theoretical and practical skill at some techniques of linear algebra that advance beyond a first course such as MATH 223 Linear Algebra 1.

Course Description: This is a second course in linear algebra, more advanced and more theoretically inclined than MATH 223. To obtain a satısfactory grade, it will be necessary to solve most of the routine problems and to answer brief theoretical questions. To obtain a high grade, it will also be necessary to solve some of the difficult problems and to give clear explanations.

Course Requirements: Knowledge of material in a first course in linear algebra, notably, the technique of diagonalization and the material behind it, such as the theory of coordinate transformations, the theory of eigenvalues and eigenvectors.

Instructor: Laurence Barker, Office SA 129, barker at fen dot bilkent dot edu dot tr.

Assistant: Mehmet Esat Akın.

Recommanded textbooks:

• Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, "Linear Algebra", 5th edition, (Pearson, 2018).

• Bill Jacob, "Linear Algebra", (W. H. Freeman, New York, 1990).

• Tom M. Apostol, "Linear Algebra", (Wiley, New York, 1997).

• Kenneth Hoffman, Ray Kunze, "Linear Algebra", 2nd edition, (Prentice–Hall, Englewood Cliffs, 1971).

See also supplementary material on my homepage and Moodle.

Classes: Tuesdays 09:30 - 10:20, Thursdays 13:30 - 15:20, room SA-Z01.

Office Hours: Tuesdays 08:30 - 09:20, in my office, room SA-129.

Office hours is for all the students on the course, not just the proficient. If you are having difficulty with the course, then it is best to come to see me for advice, and doing so before an exam might be more productive than doing so after the exam.

Weekly Syllabus

The format below is, *Week number; Monday date; Subtopics.*

1: 29 Jan: Review of diagonalization over the real and complex numbers. Rings, fields, finite fields.

2: 5 Feb: Vector spaces over arbitrary fields. Steinitz Exchange Lemma and applications. Error-correcting codes.

3: 12 Feb: Error-correcting codes. Unique factorization of polynomial rings. Annihilating polynomials of a matrix and of a linear map.

4: 19 Feb: Minimal polynomial of a linear map. Generalized eigenvectors.

5: 26 Feb: Generalized eigenvectors. Jordan normal form.

6: 4 Mar: Cayley–Hamilton Theorem and applications. *No class on Thursday.*

7: 11 Mar: Inner product spaces. Cauchy–Schwartz inequality. Triangle inequality. Orthonormal bases. Pearson correlation coefficient.

8: 18 Mar: Orthonormal bases. Gram–Schmidt orthogonalization

9: 25 Mar: Quadratic forms. Bilinear forms. Sylvester's law of inertia.

10: 1 Apr: Quadratic forms. Bilinear forms. Sylvester's law of inertia.

8 Apr: *Feast of Ramadan holiday.*

11: 15 Apr: Symmetric, Hermitian, orthogonal and unitary operators, their diagonmalizability and their spectral theorems.

12: 22 Apr: Symmetric, Hermitian, orthogonal and unitary operators, their diagonmalizability and their spectral theorems. *No class on Tuesday.*

13: 29 Apr: Skew-symmetric bilinear forms. Groups preserving bilinear forms.

14: 6 May: Rational canonical form, catching up.

15: 13 May: Review for Final.

Assessment:
• Quizzes 10%. There are to be 10 quizzes.
• Midterm 40%, Tuesday 19 March, 18:00 - 20:00, SA-Z19, SA-Z20.
• Final, 50%, time and location to be announced.

FZ criteria: Less than 30% of the sum of the Midterm 1 and Midterm 2 marks. Since the grading is by curve, this criterion may be lowered.

Speaking: All speaking in class must address everyone in the room. Questions and comments are welcome: they make learning easier, and they make teaching easier too.

Class Announcements: All students, including any absentees from a class, will be deemed responsible for awareness of class announcements.