

## STUDY GUIDE AND GENERAL INSTRUCTIONS

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### 1. Overview

This module is about matrices. It includes theoretical aspects, computational aspects and applications. The solution of a system of equations is explained and is applied to square systems, over determined systems and under determined systems.

The student is introduced to various matrix factorizations such as LU, LDU, QR, eigenvalue decomposition and the SVD, and it is demonstrated how these factorizations are applied to solve practical problems. The concept of orthogonality is explained and is applied to least squares fitting and to projections, reflections and rotations. Eigenvalue decomposition is applied to problems involving difference equations and differential equations. Singular value decomposition (SVD) is applied to image processing.

The software package MATLAB is used intensively as a computational laboratory to investigate concepts, to solve problems and as a supplement to the classroom lectures.

### 2. Resources provided

The online resources for this module consist of the following:

- **Notes:** No handbook is prescribed. Notes are available online as separate chapters.
- **Lectures and other study sources:**
  - (a) **Lectures:** Lectures will be presented in the classroom. These lectures will not be recorded.
  - (b) **Mini-talks:** For some topics, small screen-casts of short duration (about 15 minutes) that explain some concepts will be made available. These screen-casts will be called 'Mini-talks' and are downloadable, so that you do not have to use data every time you want to watch it. I have deliberately reduced their size (with some loss in quality) so that they are not too data heavy.
  - (c) **Some Recorded Lectures:** Some recorded lectures of previous years may be made available, if students request it and find it useful.

- **Sets of Problems:** Problem sets following each chapter of the notes will be available online. Some memos (mostly only the answers) for these problems will also be made available, but it is usually bad practise to supply all answers of all problems, since students tend to rely too much on this.
- **Do-It-Yourself tests:** Each week a small test, called a DIY-test, covering the work of the previous week will be posted online. You may print out this test and do it in your own time. These DIY tests will *not* be graded for marks. A memo for each of these DIY tut-tests will be provided so that you can mark it yourself, and can determine how well you know the work.

There is only one master password for accessing any chapter of the notes, any problem set, DIY-tests, or their memos. It will be provided in class and on SunLearn. Also, if you forget it, email me, and I will remind you.

### 3. Website and SunLearn site

All non-video resources will be available on the website as well.

<http://appliedmaths.sun.ac.za/TW214/>

Video resources (which require more storage) will be available only on the SunLearn site for this module.

General announcements will appear in your email but will be available also on the SunLearn site.

### 4. Assessment

Assessment for this module takes two forms:

- **Tutorial tests:** You will write a sit-in tutorial test on the work of the previous week (usually the previous three lectures) every Wednesday at 16:00. The duration of the tut-test may vary depending on the amount of work covered, but it will usually be about 25 minutes. The total of all marks obtained for the tut-tests will contribute 10% to your final pass mark.
- **Assessments:** The A1 and A2 assessments will be invigilated sit-in tests, written on paper. A1 and A2 will each contribute 45% to your final pass mark.

There is an optional A3 test for those who need it.

### 5. Class timetable

Classes are in General Engineering A406 on Monday 10:00, in A406 on Tuesday 8:00, and in A305 on Friday 11:00.

## 6. Tutorial session and DIY tests

Each chapter has a set of problems associated with it, that is available online. There are usually more problems in the set than that which are required for you to get a minimum of exercise of the work. However, I will not select problems out of the set for you — you should select enough of the problems yourself and do them.

There will be a tutorial session on Wednesdays (14:00 - 15:50) in NARGA D. After this tutorial session you will write a sit-in tut-test at 16:00 in MATH.&IND.PSY. BUILDING 1005. (This means that everybody will start moving over to this venue by about 15:50.)

In order for you to prepare yourself, there are "do-it-yourself" (DIY) tut-tests available online. When you believe that you know the material of the chapter well enough, you should print out the DIY test and write it in your own time. You may then mark it yourself using the memo that is also posted online. It is recommended that you should write the relevant DIY test before the relevant tut-test each Wednesday.

## 7. Contents

The contents of this module are as follows:

Chapter	Contents	Week
1	VECTORS (Revision)	1
2	LINES AND PLANES IN 3D (Revision)	1
3	MATRICES	2
4	SYSTEMS OF EQUATIONS, LU DECOMPOSITION	3
5	LINEAR SPACES	4
6	COLUMN AND NULL SPACES	5
7	PROJECTIONS AND REFLECTIONS	6
8	LEAST SQUARES SOLUTIONS	7
9	QR DECOMPOSITION	8
10	DETERMINANTS (Revision only)	
11	EIGENVALUES	9
12	DIFFERENCE EQUATIONS	10
13	DIFFERENTIAL EQUATIONS	11
14	SYMMETRIC MATRICES	12
15	THE SVD	13
16	THE $3 \times 3$ ROTATION MATRIX	14

## 8. Module outcomes

On completion of this module the student should be able to

- compute with matrices and vectors,
- visualize vectors, lines and planes in 2 and 3 dimensions so that mathematical

results can also be interpreted physically,

- apply matrix theory to solve a variety of practical problems (Examples are: solution of a system of linear equations, both over and under determined, solution of systems of difference and differential equations, handling of projections, reflections and rotations in 2D and 3D, as well as applications in image processing), and
- use MATLAB in these activities.

A more detailed list of outcomes will be posted on the web site.

## **9. Communication**

If you ask a question on the SunLearn forum, I will answer it. These questions and their answers are visible to everyone.

If you send questions to me by email, I will also answer them. The answer will only be visible to you.

I wish you the best with this module.

MF MARITZ

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