APPLIED MATHEMATICS 20710-214

(Applied Matrix Methods)

MODULE INFORMATION SHEET

Lecturer: Dr M F Maritz First semester, 2017.

1. Introduction

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 in population dynamics and electrical systems. Singular value decomposition (SVD) is applied to image processing. The sensitivity of linear systems w.r.t. computer rounding is discussed as well.

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

2. Website

Information for this module will be updated regularly on the following web site:

`http://dip.sun.ac.za/~mfmaritz/T214/index.html`

We do not make use of SUNLEARN (although there will be a link from SUNLEARN to this web site.)

3. Module information

Module code: 20710–214	Module: Applied Mathematics TW214		US Credits 16
Year: 2 Semester: 1	Lecturing load: 3.00ℓ, 3.00 t (per week)	Home department: Applied Mathematics	
Lecturer: Dr MF Maritz	Office: A416	Telephone: 021-808-4228	Email: mfmaritz@sun.ac.za
Classification:	Mathematics: 60%	Basic Science: 30%	Applied Science: 10%
Prerequisites:	Pass None	Prerequisite Wisk 144	Co-requisite None
Other knowledge:	Basic knowledge of calculus and vectors		
Assessment	Method: Continuous Evaluation	Pass mark formula: PM=0.66×CTM+0.34×TTM PM=Pass Mark CTM=Class Test Mark TTM=Tut Test Mark	

4. 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.

5. Study materials

No handbook is prescribed. A complete set of notes is made available on the web site under the tab *Notes*. (You do save quite some money because of this.)

6. Test dates

See the web site for test dates.

7. Assessment

The assessment of this module is done according to the method of *Continuous Evaluation*.

You will write two large tests called *Class Tests*, each covering about one half of the work done during the semester. The marks obtained for these two tests contribute towards 66% of your final pass mark (33% each). There will be an optional third test during the examination period, which must be written only by those who do not yet have enough marks to pass. The third optional test will cover all the work done during the semester, and the marks of this test will replace the marks of your worst class test.

Every week, you will also write a smaller test, called the *Tut Test*.

You will have the opportunity to do some exercise problems during the tutorial session every week, where help from the lecturer and student assistants will be available. This will be from 14:00-15:50 in a NARGA venue with computers so that you can also experiment with MATLAB during the session. Some tut tests may include a MATLAB exercise and this will be done in the NARGA venue.

After the tutorial session, everybody will have about 20 minutes to move over to the venue where the tut test is written.

This test is written at about 16:10 and covers the work done during that tutorial session. You should therefore not waste time during the tutorial session, but start working immediately, because you will be tested on your knowledge of that work about two hours later. Tutorial problems are available on the web site, so that you may already start working on these problems at home.

The marks obtained for the Tut Tests will contribute to the remaining 34% of your final pass mark.

8. Module Content

The following topics will be covered:

— Introduction to vectors (superficial, as a revision),
— Solution of linear equations and LU as well as LDU decomposition,
— Matrix notation and en manipulation rules,
— Vector spaces, and the column and null spaces of a matrix,
— Projections, reflections and rotations in 3D,
— Orthogonality, least squares solutions and QR decomposition,
— Eigenvalues, eigenvectors and diagonalisation,
— Systems of difference equations and systems of differential equations,
— Analysis of quadratic curves,
— Singular value decomposition with applications,
— Condition number and ill-conditioned matrices.

A schedule of what will be presented in each lecture is available on the web site under the link `Schedule`.

9. Periods

Formal Lectures :				
Monday	10:00	–	10:50	(in A305)
Tuesday	08:00	–	08:50	(in A305)
Friday	11:00	–	11:50	(in A305)
Tutorial session :				
Wednesday	14:00	–	15:50	(in NARGA H)
Tutorial test :				
Wednesday	16:10	–	16:50	(in A305, A404)

It is the responsibility of each student to see that he/she is registered for the module and that no time table clashes occur.