TW776 **Numeriese Metodes / Numerical Methods** **2020**

Lecturer:

Lecturer: Prof JAC Weideman

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Module:

Web page: http://appliedmaths.sun.ac.za/TW776/

Credits: 16

Time: TBC

Place: TBC

Contents: The module focuses on matrix computations. We study the effective solution of linear systems, involving both square and rectangular matrices (least-squares). Direct as well as iterative methods are considered, with the emphasis on sparse matrices and matrices with structure. Numerical methods for the eigenvalue problem are also considered. Pitfalls such as numerical instability and ill-conditioning are pointed out. Model problems are taken from partial differential equations, data analysis and image processing. Theory, algorithmic aspects, and applications are emphasized in equal parts.

Prerequisites: An undergraduate module in matrices/linear algebra plus some programming experience in an environment such as MATLAB or Python.

Text: We plan to cover a few chapters from M. T. Heath, *Scientific Computing: An Introductory Survey 2nd ed*, SIAM, 2018. Further resources will be recommended on the web page throughout the term.

Outcomes: Upon completion of the module the student will: Be able to analyze errors in matrix computations using matrix and vector norms. Be able to distinguish between numerical instabilities in algorithms and ill-conditioned problems. Implement basic direct algorithms for solving dense square linear systems and overdetermined rectangular systems, as well as iterative algorithms for sparse systems. Be able to compute various matrix factorizations such as the LU and QR decompositions, and the eigenvalue decomposition. Be able to analyze speed of convergence in iterative methods such as the Jacobi, Gauss-Seidel, and conjugate gradient methods. Be able to apply these tecniques in solving PDEs and other application areas.

Assessment: Continuous assessment, based on computer assignments and written tests. Assignments are due at regular intervals throughout the semester. Please watch the web page for announcements. There are also two tests that cover theory (each covering about half of the work of the semester; dates to be announced on the web page). Final marks are calculated as follows:

Test 1	33 %
Test 2	33 %
Assignments	34 %
	100 %

Pass mark	50 %
Distinction	75 %