



Applied Mathematics / *Toegepaste Wiskunde* 20710-214
 APPLIED MATRIX METHODS / *TOEGEPASTE MATRIKSMETODES* (2017)

SCHEDULE/ SKEDULE

This table is being modified as the module progresses. / Hierdie tabel word opgedateer soos wat die module vorder.

Those cells colored white are future days and the description is "**What is planned for that class.**"
 Selle wat wit ingekleur is, is toekomstige dae en die inhoud daarvan is "**Wat beplan word vir daardie klas.**"

Those cells colored light orange are past days and the entry is "**What has been done in class.**"
 Selle wat lig oranje ingekleur is, is dae wat verby is en die inhoud daarvan is "**Wat in die klas gedoen is.**"

Lecture no Lesing no	Date Datum	Day Dag	Chapter, Section	Contents / Inhoud
1	30-Jan	Mon		VECTORS: Introduction: Vectors: notation, lengths, the dot product, angles, orthogonal vectors,
2	31-Jan	Tue		VECTORS: Short intro. to MATLAB, Sets of vectors, lines, planes
T	1-Feb	Wed		TUT 1: [1] TT 1
3	3-Feb	Fri		VECTORS: Parallelograms and triangles in space, MATRICES: Notation, elements, indices, sizes.
4	6-Feb	Mon		MATRICES: Matrix multiplication, Non-commutativity, Pre- and post multiplication, The Four views of matrix multiplication, Transposes and rules, The identity matrix and inverses.
5	7-Feb	Tue		MATRICES: (Symbolic) matrix equations, Square and rectangular matrices, Inverses, Powers of matrices, Diagonal matrices (scales the rows or the columns)
T	8-Feb	Wed		TUT 2: [2] TT 2
6	10-Feb	Fri		LU-DECOMP: Permutation matrices, 3x3 systems of equations: row picture, column picture, break-up picture, pre- and post-multiplication,
7	13-Feb	Mon		LU-DECOMP: Elementary matrices, pivots, multipliers, LU-decomposition, A 3x3 example, forward and backward substitution
8	14-Feb	Tue		LU-DECOMP: Permutation matrices and row exchanges, A singular case with (a) no solution (b) infinitely many solutions
T	15-Feb	Wed		TUT 3: [3] TT 3
9	17-Feb	Fri		LU-DECOMP: Uniqueness and LDU decomposition SPACES: Geometric interpretation, lines and planes through the origin
10	20-Feb	Mon		SPACES: Rules for Vector spaces (closure addition, closure scalar mult.), geometric interpretation of VS's (lines, plane, etc.) , Introduction to linear independence, examples
11	21-Feb	Tue		SPACES: The Column space, "independence, basis, span, dimension", Example of finding a column space, the Null space, First example of rectangular LU
T	22-Feb	Wed		TUT 4: [4] TT 4
12	24-Feb	Fri		SPACES: The Column space and the Null space, Rectangular LU-decomposition, example (landscape), example (portrait)
13	27-Feb	Mon		SPACES: Example underdet. system: Find parabola through 2 points, Example null space: derive cross product, Summary: Systems of equations, rank, The four fundamental spaces of a matrix, row-, column-, null-, and left null spaces, Rank, pivots
14	28-Feb	Tue		PROJECTIONS: Geometric introduction, Projections on a line, Properties of P, Projections on a plane, MATLAB DEMO
T	1-Mar	Wed		TUT 5: [5] , [6] TT 5
15	3-Mar	Fri		PROJECTIONS: Projections on a plane, Properties of P, MATLAB DEMO
16	6-Mar	Mon		REFLECTIONS: Reflections through a line, or a plane. Properties of H, Flat mirrors in 3D, application of the retro reflector
17	7-Mar	Tue		REFLECTIONS: Curved mirrors in 2D, the parabolic mirror. LS-SOLUTIONS: Introduction to Least-Squares solution, the normal equations
T	8-Mar	Wed		TUT 6: [7] , [8] TT 6
18	10-Mar	Fri		LS-SOLUTIONS: Least-Squares solutions, Fitting curves to points, Formulae for a and b of a 'best' line of the form $y=ax+b$.
CT 1	10-Mar	Fri	CT 1	CLASS TEST 1 (10 Mar 2017)
19	13-Mar	Mon		LS-SOLUTIONS; Summary of the types of systems solved up to now. ORTHOGONALITY: Definition, Orthogonal and orthonormal bases, Orthogonal matrixes, Properties of Q, Introduction to Gram-Schmidt
20	14-Mar	Tue		ORTHOGONALITY: Gram-Schmidt, QR and how to save work, QR full example, reduced QR and least squares solution
T	15-Mar	Wed		TUT 7: [9] TT 7
21	17-Mar	Fri		ORTHOGONALITY: reduced QR, example least squares solution. REVISION: rectangular QR and least-squares solution,

	20-Mar	Mon		CLASS FREE DAY
	21-Mar	Tue		HUMAN RIGHTS DAY
T	22-Mar	Wed		TUT 8: [10]
22	24-Mar	Fri		(Monday time table) DETERMINANTS: Short revision
23	27-Mar	Mon		EIGENVALUES: Intro, 2x2 example, 3x3 example (factorizable), Example, 3x3, using $\text{Tr} = \text{sum of Eigs}$, $\text{det} = \text{product of eigs}$. Diagonalisation of A
24	28-Mar	Tue		EIGENVALUES: diagonal decomposition, 2x2 example, power series and the matrix exponential, $\text{tr}(A) = \text{sum}$, $\text{det}(A) = \text{prod}$ for 3x3 matrix
T	29-Mar	Wed		TUT 9: []
25	31-Mar	Fri		DIFF'CE EQN's: 1x1 case, solution, 2x2 case, solution with diagonalization, Application: population moves to and from the Western Cape, second order diff'ce eq as 2x2 system of first order ode
26	3-Apr	Mon		DIFF'CE EQN's: example: determinants of banded matrices -> the Fibonacci system, full solution ODE'S: review of simple first order differential equation
27	4-Apr	Tue		DIFF'CE EQN's: Application - Monopoly ODE'S: Introduction, Theory, exmp of a diagonal matrix
T	5-Apr	Wed		TUT 10: []
28	7-Apr	Fri		ODE'S: Theory derived again, fully worked 2x2 example, Simple harmonic motion as an example of second order ode, conversion of second order ode to 2x2 system of first order odes
				APRIL HOLIDAYS
	17-Apr	Mon		FAMILY DAY
29	18-Apr	Tue		ODE'S: Example: Undamped SHM fully worked, Example system of two tanks SYM MATS: Review of complex numbers, the transpose of complex matrices, Proof: Eig-vals of sym-mats
T	19-Apr	Wed		TUT 11: [] Differential equations
30	21-Apr	Fri		SYMMETRIC MAT's: Example with multiple eigenvalues. Mention Jordan form. QUADRATIC CURVES: introduction, revision of conic sections
31	24-Apr	Mon		QUADRATIC CURVES: example done forward (along axes, then rotate, then shift), demo in MATLAB, no shift, find rotation and axes, Theory, Example
32	25-Apr	Tue		QUADRATIC CURVES: one more example, hyperbola
T	26-Apr	Wed		TUT 12: [] Quadratic curves
33	28-Apr	Fri		SVD: Introduction, eigshow, one complete example, properties of the SVD: rotate-scale-rotate, rank-1 decomposition
	1-May	Mon		WORKERS' DAY
34	2-May	Tue		SVD: more examples, Demo: image compression, Bases for the 4 fundamental subspaces of A and the SVD of A. Using SVD to solve systems.
35	3-May	Wed		(Monday timetable) ROTATION MATRICES: Introduction, Cross-product matrix, properties.
36	5-May	Fri		SVD: Bases for the 4 fundamental subspaces of A and the SVD of A. Using SVD to solve systems.
37	8-May	Mon		ROTATION MATRICES: full derivation, using trace and transposes to find a and theta, Examples
38	9-May	Tue		ROTATION MATRICES: Application CONDITIONING: Ill-conditioned systems, the condition number
T	10-May	Wed		TUT 13: [] Rotation matrices
39	12-May	Fri		CONDITIONING: examples PRESENTATION: How LA is used in industry (some examples)
CT 2	27-May	Sat	CT 2	CLASS TEST 2 (27 May 2017, 14:00)
CT 3	???	???	CT 3	CLASS TEST 3 (to be determined)