



Applied Mathematics / *Toegepaste Wiskunde* 20710-214
 APPLIED MATRIX METHODS / *TOEGEPASTE MATRIKSMETODES* (2023)

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 | 13-Feb | Mon | [1], [2] | VECTORS: review, notation, lengths, dot product, angles LINES AND PLANES: Lines in 3D |
| 2 | 14-Feb | Tue | [2] | LINES AND PLANES: Planes in 3D, Examples, intersections of planes, lines |
| T | 15-Feb | Wed | | TUT 1: [1] Vectors,length, dot product, angles, Lines in 3D, Planes in 3D TT 1. |
| 3 | 17-Feb | Fri | [3] | MATRICES: Notation, elements, indices, sizes .The Four views of matrix multiplication, Transposes and rules, The identity matrix and inverses. |
| 4 | 20-Feb | Mon | [3] | MATRICES: Matrix multiplication, Non-commutativity, Pre- and post multiplication, |
| 5 | 21-Feb | Tue | [3] | MATRICES: (Symbolic) matrix equations, Square and rectangular matrices, Inverses, Powers of matrices, Diagonal matrices (scales the rows or the columns) |
| T | 22-Feb | Wed | | TUT 2: [2] MATRICES, Symbolic solutions TT2 |
| 6 | 24-Feb | Fri | [4] | LU-DECOMP: Permutation matrices, Elementary matrices, pivots, multipliers, LU-decomposition, A 3x3 example |
| 7 | 27-Feb | Mon | [4] | LU-DECOMP:2x2 systems of equations: row picture, column picture, singularity picture, 3x3 singularity,Elementary matrices, pivots, multipliers, LU-decomposition |
| 8 | 28-Feb | Tue | [4] | LU-DECOMP: One more 3x3 example, Permutation matrices and row exchanges, A singular case with (a) no solution (b) infinitely many solutions |
| T | 1-Mar | Wed | | TUT 3: [3] SYSTEMS, LU-DECOMP TT 3 |
| 9 | 3-Mar | Fri | [4] | SPACES: Vector spaces, Two Closure Rules for Vector spaces, some examples, geometric interpretation as lines and planes through the origin |
| 10 | 6-Mar | Mon | [5] | SPACES: Introduction to linear independence, examples |
| 11 | 7-Mar | Tue | [5] | SPACES: INDEPENDENCE, "independence, basis, span, dimension", geometric interpretation of independence, independence in an upper echelon matrix |
| T | 8-Mar | Wed | | TUT 4: [4] SPACES TT 4 |
| 12 | 10-Mar | Fri | [5] | COL & NULL SPACES: The Column space and the Null space, Rectangular LU-decomposition, example (landscape), application (parabola through two points) |
| 13 | 13-Mar | Mon | [6] | COL. & NULL SPACES: Rank of a matrix, Dimension of a space, Underdet syst. Balancing chemical reactions, Overdet. Syst. Example, col,null space,solution |
| 14 | 14-Mar | Tue | [6] | COL. & NULL SPACES: , Example underdet. system: Find parabola through 2 points. PROJECTIONS AND REFLECTIONS: Projection on a line, the projection matrix |
| T | 15-Mar | Wed | | TUT 5: [5] , [6] COL 7 NULL SPACE TT 5 |
| 15 | 17-Mar | Fri | [7] | PROJECTIONS AND REFLECTIONS: Projections on a line, Properties of P, Projection on plane, Properties of P, MATLAB DEMO |
| 16 | 20-Mar | Mon | [7] | PROJECTIONS AND REFLECTIONS: Summary of projections, Reflections through a line, or a plane. Properties of H |
| | 21-Mar | Tue | | HUMAN RIGHTS DAY |
| T | 22-Mar | Wed | | TUT 6: [7] Projections & Reflections TT 6 |
| 17 | 24-Mar | Fri | [7] | PROJECTIONS AND REFLECTIONS: Summary of Reflections, Curved mirrors (2D) , Flat mirrors in 3D, application: the retro reflector |
| 18 | 27-Mar | Mon | [8] | LS-SOLUTIONS: Introduction to Least-Squares solution, derivation of the normal equations. Fitting curves to points, Formulae for a and b of a 'best' line of the form $y=ax+b$. Fitting a parabola. MATLAB demo |
| 19 | 28-Mar | Tue | [8] | LS-SOLUTIONS: Summary, Fitting a plane to data. ORTHOGONALITY: Definition, Orthogonal and orthonormal bases, Orthogonal matrixes, Properties of Q. |
| T | 29-Mar | Wed | [8] | TUT 7: [8] Least-squares solutions TT 7 |
| 20 | 31-Mar | Fri | | ORTHOGONALITY: Gram-Schmidt, QR and how to save work, QR full example, reduced QR and least squares solution |
| HOLIDAYS (1 Apr - 10 Apr) | | | | |

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|----|--------|-----|------|---|
| 21 | 11-Apr | Tue | [9] | ORTHOOGONALITY: Summary of QR, Reduced QR, Solving Overdet. Systems with Reduced QR. |
| T | 12-Apr | Wed | [9] | TUT 8: [9] QR-DECOMP TT 8 |
| 22 | 14-Apr | Fri | [10] | [Monday Timetable] DETERMINANTS: Short revision, EIGENVALUES: Intro, 2x2 example, 3x3 example (factorizable) |
| 23 | 17-Apr | Mon | [11] | EIGENVALUES: eigenvalues of the 3x3 matrix (general), examples, degenerate example |
| 24 | 18-Apr | Tue | [11] | EIGENVALUES: Taylor series: a short informal intro, power series and the matrix exponential, difference equations |
| T | 19-Apr | Wed | | TUT 9: EIGENVALUES TT 9: eigenvalues, and diagonal decomposition |
| 25 | 21-Apr | Fri | [12] | DIFF'CE EQN's: 1x1 case, solution, 2x2 case, solution with diagonalization, Application: cars in JHB and CPT, second order diff'ce eq as 2x2 system of first order ode |
| 26 | 24-Apr | Mon | [12] | DIFF'CE EQN's: example: determinants of banded matrices -> the Fibonacci system, full solution, Application Monopoly |
| 27 | 25-Apr | Tue | [13] | ODE's: Introduction, Theory, expm of a diagonal matrix, fully worked 2x2 example, |
| T | 26-Apr | Wed | | No tut today |
| | 26-Apr | Wed | | TEST A1 |
| 28 | 28-Apr | Fri | [13] | 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 |
| | 1-May | Mon | | WORKER'S DAY |
| 29 | 2-May | Tue | [13] | 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 | 3-May | Wed | | TUT 10: [12] DIF'CS EQ's [13] ODEs TT 10: |
| 30 | 5-May | Fri | [14] | SYMMETRIC MAT's: Example with multiple eigenvalues. Mention Jordan form. QUADRATIC CURVES: introduction, revision of conic sections |
| 31 | 8-May | Mon | [14] | QUADRATIC CURVES: example done forward (along axes, then rotate, then shift), demo in MATLAB, no shift |
| 32 | 9-May | Tue | [15] | SVD: introduction, ellipse, MATLAB demo. |
| T | 10-May | Wed | | TUT 11: SYM, QUAD-curves TT 11 |
| 33 | 12-May | Fri | [15] | SVD: one example, properties of the SVD, rotate-scale-rotate, rank-1 decomposition |
| 34 | 15-May | Mon | [15] | SVD: applications, and more examples |
| 35 | 16-May | Tue | [16] | ROTATION MATRICES: Introduction, Cross-product matrix, properties. |
| T | 17-May | Wed | | TUT 12: SVD TT 12 |
| 36 | 19-May | Fri | [16] | ROTATION MATRICES: full derivation, using trace and transposes to find α and θ , Examples, Applications |
| | 22-May | Mon | | EXAMINATION PERIOD STARTS |
| | 10-Jun | Sat | | TEST A2 |
| | t.b.a. | | | TEST A3 |
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