**Math 102 SYLLABUS**

COURSE NAME: Applied Linear Algebra- Math 102
DETAILS: 3 hour lectures, 1 hour lab sections
TERM: Winter

COURSE DESCRIPTION

3.5 (fi 6) (either term, 3-0-1) Vectors and matrices, solution of linear equations, equations of lines and planes, determinants, matrix algebra, orthogonality and applications (Gram-Schmidt), eigenvalues and eigenvectors and applications, complex numbers.

REQUIRED MATERIAL

The textbook that has been used in recent years is the following; once we are confident of the new content, we need to find a more suitable source:

* Elementary Linear Algebra, by Anton (Wiley)

LECTURE CONTENT

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| **Week** | **Dates** | **Topics** | **Text / Details** |
| **1****Lec****1****2****3** | Jan81012 | R^n | 3.1: points, arrows, vectors; vector addition, scalar multiplication; linear motion,linear combination, span with basic examples:parallelogram, parallelepiped in R^2 and R^3 |
|  |  |  | **Labs start Jan 15** |
| **2****Lec****4****5****6** | Jan151719 | Complex numbers; C^n with R^n as its real part | Appendix B: Complex numbers, real/imaginary partsaddition, multiplication, conjugation, norm, inversion;Polar form and geometric properties of multiplication;Roots of unity; n-th roots of arbitrary complex numbers;Factoring **R**-polynomials over **C**5.3 C^n light |
| **3****Lec****7****8****9** | Jan222426 | Norm, dot product in R^n, geometry of systems of linear equations | 3.2, 3.3: algebraic and geometric properties of norm and dot product, orthogonality, projection theorem, point normal equation of a hyperplane, distance of a point from a hyperplane |
| **Week** | **Dates** | **Topics** | **Text / Details** |
| **4****Lec****10****11****12** | Jan2931Feb 2 | Solving systems of linear equations via reduction to RREF /light contact with linear equations in C^nMatrices | 1.1, Systems of linear equations / (un-)augmented coefficient matrix1.2 RREF, Gauss-Jordan elimination; rank, expressing solutions as (a) shifted span of vectors coming from Gauss-Jordan elimination, (b) intersection of hyperplanes, number of solutions (connect to week 3)1.3 Matrices, types of matrices, addition, scalar multiplication, multiplication, Matrix transposition; |
|  |  | **Material relevant on mid term exam: up to 1.2; not 1.3** | **Friday, Feb. 9, 18:00** |
| **5****Lec****13****14****15** | Feb579 | Matrices and matrix algebra | 1.4 invertibility, matrix inversion and its properties;1.6 Matrix equation vs. system of linear equations(no 1.5: elem. matrices); 1.8???From 4.9/4.11 Concept of matrix transformations: along with basic examples: identity, 0-trafo, contraction, dilation, rotation, shear trafo |
| **6****Lec****16****17****18** | Feb121416 | Determinants | 2.1 Cofactor expansion of determinant; alternating & multilinear properties of determinants, commutes with transposition;2.2 evaluation by row column operations; orientation of **R**^n; interpretation as oriented area in R^2, oriented volume; in R^3; (no adjoint; Cramer) |
| **7** | Feb19-23 | **Winter Term Reading Week** |  |
| **8****Lec****19****20****21** | Feb2628Mar 2 | Cross product; Subspace | 3.5 cross product; algebraic and geometric properties; relationship: dot, cross, determinant4.2 Primary means to create subspaces: span, orthogonal complement; examples: row, column, null space. |
| **9****Lec****22****23****24** | March5\*79 | Subspaces, dimension | 4.3 Linear independence; ON-set linear ind; determinant test4.4 basis, statement of existence; coordinate vectors;4.5 dimension |
| **10****Lec****25****26****27** | March121416 | Subspaces continued;Orthogonal splittings and applications | 4.7 Bases for row, column, null space;4.8 Rank and nullity - dimension formula4.6 Change of basis;6.3 OB’s,; ONB’s; Gram-Schmidt orthonormalization; Orthogonal splittings and projections; |
| **11****Lec****28****29****30** | March192123 | Orthogonal splittings completedLinear Transformations / matrix transformations | 6.4 apps via least squares approximationsLinear transformations between subspaces;1.8 Matrix representation of linear trafo;4.10 / 4.11 sum/scalar product/composition of linear trafos and relationship to their representing matrices |
| **12****Lec****31****32** | March2628 | Linear Transformations / matrix transformations continued | 4.10 / 4.11 continued; projection onto / reflection about hyperspace; Isomorphism-invertibility7.1 orthogonal matrices (including general rotations in R^3), isometries |
| **13****Lec****33****34** | April46 | Eigentheory | 5.1 Eigenvectors, eigenvalues by inspection in orthogonal reflection / projection / rotation; eigenspaces5.2 algebraic/geometric multiplicity, diagonalization |
| **14****Lec****35****36****37** | April91113 | Eigentheory completed | 7.2 (orthogonal) diagonalization via ON-change of basis5.3 skewed rotations & complex eigenvalues of (2,2)-matrices,time permitting: of (3,3)-matricesCatch up and closing session |

LAB CONTENT

* 1 weekly computer lab