# 201.1.9321. LINEAR ALGEBRA FOR MECHANICAL ENGINEERING. BGU, SPRING 2016.

The site of the course: *www.math.bgu.ac.il/ ∼ kernerdm*

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The structure of the final grade
There will be about 10-12 homeworks. There will be one midterm (9.06.2016).
The final mark is computed as: $10\%(midterm) + 90\%(final\ exam)$.
The final exams are: Moed A (July 19) , Moed B (August??).

The textbook: Prof. Amnon Yekutieli "Introduction to Linear Algebra" (in Hebrew):
`http://www.math.bgu.ac.il/~amyekut/book/lin_alg_book.html`

The program of the course (the timings are approximate and will be adjusted during the semester)

(1) *Fields (one week).* Sets of numbers, naturals, integers, rationals, reals. Fields. The field of complex numbers, the Cartesian representation, the Polar representation, the Exponential representation. Theorem of d'Moivre, root computations. Finite fields, remainders modulo $p$.
(2) *Systems of linear equations (1-1.5 weeks).* Systems of linear equations over any field. Equivalent systems. The Gauss elimination algorithm. The solution set and its parametric representation. Echelon form and the reduced echelon form of a matrix. Number of solutions of a linear system. Homogeneous linear systems.
(3) *Vector spaces (2 weeks).* The definition and examples. Vector sub-spaces, linear combinations and the span of a set of vectors. Linear (in)dependence. The basis and the dimension of a vector space. Intersections and sums of vector spaces. The theorem of dimensions. Coordinates of a vector in a given basis.
(4) *Matrices (1 week).* The general introduction. Representation of linear systems using matrices. Product of matrices. Elementary matrices. Invertible matrices. Row spaces and column spaces of matrices. The rank of a matrix.
(5) *Determinants (1 week).* Inductive definition, expansion by rows/columns. Properties of determinants. Cramer's rule.
(6) *Linear maps between vector spaces (2 weeks).* Definition and examples. The kernel of a map and the image of a map. The dimension theorem for linear mappings. The matrix representation of finite dimensional linear mappings. The composition of mappings and the multiplication of matrices. Linear operators. Invertible mappings and isomorphisms. The change of basis.
(7) *Eigenvalues and the diagonalization of operators (2-3 weeks).* Eigenvalues, eigenvectors, eigenspaces. The characteristic polynomial. Algebraic/geometric multiplicity of an eigenvector. The diagonalization of operators and matrices. Polynomials of diagonalizable matrices. Cayley-Hamilton theorem for diagonalizable matrices. Similarity of matrices.
(8) *Inner product spaces (2-3 weeks).* Inner product, the geometry of inner product spaces (the norm of a vector, orthogonality, the Cauchy-Schwarz inequality). The orthonormal sets of vectors, the Gram-Schmidt algorithm, direct sum of subspaces. The orthogonal complement of a sub-space. The projection onto a subspace. Self-conjugate operators, matrices and their diagonalization.