

# Basics of Mathematics

**Subject Code and Course Number:** 0105/U25

**Course Title:** Basics of Mathematics

**Number of Credits:** 3

**Instructor Name:** Karen Keryan. Teaching Associate: Nerves Srapionyan

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**Term/Year:** Fall 2018

**Class Schedule:** Tuesday: 18:30 – 19:50 in 203, Faculty of Math&Mech

**Course Description** This course briefly covers topics including: Matrices, Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Inner Products, Orthogonality, Orthonormal Basis, Orthogonal Projections, Determinants and Traces, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigendecomposition and Diagonalization, Singular Value Decomposition, Differentiation of Univariate, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions and of Matrices, , Higher-order Derivatives, Multivariate Taylor series, Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule and Bayes' Theorem, Summary Statistics and Independence, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family. Students are required to complete weekly problem sets in order to develop basic proficiency in the mathematical foundations introduced in the fields of Linear Algebra, Calculus and Probability. Two hours of instructor-led class time per week including discussions and problem sets.

**Required Materials:** [DFO] *Mathematics for Machine Learning* by Marc Peter Deisenroth, A Aldo Faisal, and Cheng Soon Ong. <https://mml-book.github.io/>

## Additional textbooks:

[P] *Linear Algebra: A Modern Introduction*, Fourth Edition, by David Poole

[S] *Calculus: Early Transcendentals*, 7<sup>th</sup> edition, by James Stewart

[R] *A First Course in Probability*, 8th Ed, by Sheldon Ross

## Schedule & Topics:

Week	Topic	Reading	Non-Reading Home Tasks
1	Matrices, Systems of Linear Equations	[DFO] 2.2-2.3	
2	Vector Spaces, Linear Independence	[DFO] 2.4-2.5	Homework 1
3	Basis and Rank	[DFO] 2.6	Homework 2
4	Linear Mappings	[DFO] 2.7	Homework 3
5	Inner Products, Orthogonality, Orthonormal Basis	[DFO] 3.1-3.5	Homework 4
6	Orthogonal Projections	[DFO] 3.6-3.7	Homework 5
7	Determinants and Traces, Eigenvalues and Eigenvectors, Cholesky Decomposition , Eigendecomposition and Diagonalization	[DFO] 4.1-4.4	Homework 6
8	Singular Value Decomposition	[DFO] 4.5	
9	Differentiation of Univariate, Partial Differentiation and Gradients	[DFO] 5.1-5.2	Homework 7

10	Gradients of Vector-Valued Functions and of Matrices,	[DFO] 5.3-5.5	Homework 8
11	Higher-order Derivatives, Multivariate Taylor series	[DFO] 5.7-5.8	Homework 9
12	Construction of a Probability Space, Discrete and Continuous Probabilities	[DFO] 6.1-6.2	Homework 10
13	Sum Rule, Product Rule and Bayes' Theorem, Summary Statistics and Independence	[DFO] 6.3-6.4	Homework 11
14	Summary Statistics and Independence	[DFO] 6.5	Homework 12
15	Gaussian Distribution, Conjugacy and the Exponential Family	[DFO] 6.6-6.7	