University of Debrecen
Faculty of Science and Technology
Institute of Mathematics

BSc Program

MATHEMATICS

Mathematics BSc

Basics

Code	Subject	Credit	Hours/week		Examination	Prerequisites	Semester
			Theory	Practice			
TTMBG0001	Basics of mathematics	0		1	A		1
TTMBE0101	Introduction to algebra and number theory	3	2		C	TTMBG0101(p)	1
TTMBG0101	Introduction to algebra and number theory	3		3	T		1
TTMBE0102	Linear algebra 1.	3	2		C	TTMBG0102(p)	1
TTMBG0102	Linear algebra 1.	2		2	T		1
TTMBE0103	Linear algebra 2.	3	2		C	TTMBE0102 TTMBG0103(p)	2
TTMBG0103	Linear algebra 2.	2		2	T	TTMBE0102	2
TTMBE0104	Algebra 1.	3	2		C	TTMBE0101 TTMBE0102 TTMBG0104(p)	2
TTMBG0104	Algebra 1.	2		2	T	TTMBE0101 TTMBE0102	2
TTMBE0105	Algebra 2.	3	2		C	TTMBE0104 TTMBG0105(p)	3
TTMBG0105	Algebra 2.	2		2	T	TTMBE0104	3
TTMBE0106	Number theory	3	2		C	TTMBE0104 TTMBG0106(p)	3
TTMBG0106	Number theory	2		2	T	TTMBE0104	3
TTMBE0107	Combinatorics and graph theory	4	3		C	TTMBG0107(p)	1
TTMBG0107	Combinatorics and graph theory	2		2	T		1
TTMBE0201	Sets and functions	3	2		C	TTMBG0201(p)	1
TTMBG0201	Sets and functions	2		2	T		1
TTMBE0202	Introduction to analysis	4	3		C	TTMBE0201 TTMBG0202(p)	2
TTMBG0202	Introduction to analysis	2		2	T	TTMBE0201	2
TTMBE0203	Differential and integral calculus	4	3		C	TTMBE0202 TTMBG0203(p)	3
TTMBG0203	Differential and integral calculus	3		3	T	TTMBE0202	3
TTMBE0204	Differential and integral calculus in several variables	4	3		C	TTMBE0203 TTMBG0204(p)	4
TTMBG0204	Differential and integral calculus in several variables	3		3	T	TTMBE0203	4
TTMBE0205	Measure and integral theory	3	2		C	TTMBE0203	4
TTMBE0206	Ordinary differential equations	3	2		C	TTMBE0204 TTMBG0206(p)	5
TTMBG0206	Ordinary differential equations	2		2	T	TTMBE0204	5
TTMBE0301	Geometry 1.	3	2		C	TTMBG0301(p)	1
TTMBG0301	Geometry 1.	2		2	T		1
TTMBE0302	Geometry 2.	3	2		C	TTMBE0102	2

						TTMBG0302(p)	
TTMBG0302	Geometry 2.	2		2	T	TTMBE0102	2
TTMBE0303	Differential geometry	3	2		C	TTMBE0302 TTMBE0204 TTMBG0303(p)	5
TTMBG0303	Differential geometry	2		2	T	TTMBE0302 TTMBE0204	5
TTMBE0304	Vector analysis	3	2		C	TTMBE0204 TTMBG0304(p)	6
TTMBG0304	Vector analysis	2		2	T	TTMBE0204	6
TTMBE0401	Probability theory	4	3		C	TTMBE0205 TTMBG0401(p)	5
TTMBG0401	Probability theory	2		2	T	TTMBE0205	5
TTMBE0402	Statistics	4	3		C	TTMBE0401 TTMBG0402(p)	6
TTMBG0402	Statistics	2		2	T	TTMBE0401	6
TTMBG0601	Introduction to informatics	2		3	T		1
TTMBG0602	Programming languages	2		2	T		2
	Basic information	0		1	A		1

Advanced prof module

Code	Subject	Credit	Hours/week		Examination	Prerequisites	Semester
			Theory	Practice			
TTMBE0109	Applied number theory	3	2		C	TTMBE0106	4
TTMBG0110	Algorithms in algebra and number theory	3		3	T	TTMBE0106	4
TTMBE0111	Introduction to cryptography	3	2		C	TTMBE0109 TTMBG0111(p)	5
TTMBG0111	Introduction to cryptography	2		2	T	TTMBE0109	5
TTMBE0209	Numberical analysis	4	3		C	TTMBE0102 TTMBE0203 TTMBG0209(p)	4
TTMBG0209	Numberical analysis	2		2	T	TTMBE0102 TTMBE0203	4
TTMBG0210	Analysis with computer	3		3	T	TTMBE0203	6
TTMBE0211	Economic mathematics	3	2		C	TTMBE0204 TTMBG0211(p)	5
TTMBG0211	Economic mathematics	2		2	T	TTMBE0204	5
TTMBG0308	Computer geometry	3		3	T	TTMBE0302	3
TTMBE0606	Algorithms	3	2		C	TTMBE0107 TTMBG0606(p)	2
TTMBG0606	Algorithms	2		2	T	TTMBE0107	2
TTMBE0607	Linear programming	3	2		C	TTMBE0102 TTMBG0607(p)	3
TTMBG0607	Linear programming	2		2	T	TTMBE0102	3
TTMBE0608	Nonlinear optimization	3	2		C	TTMBE0204 TTMBG0608(p)	5
TTMBG0608	Nonlinear optimization	2		2	T	TTMBE0204	5
TTMBG0403	Computer statistics	2		2	T	TTMBE0401	6

Others

Code	Subject	Credit	Hours/week		Examination	Prerequisites	Semester
			Theory	Practice			

TTFBE2211	Classical mechanics	4	2	1	C	TTMBE0203	4
TTFBE2212	Theoretical mechanics	4	2	1	C	TTFBE2211 TTMBE0206	6
TTTBE0030	European Union studies	1	1		C		1
TTTBE0040	Basic environmental science	1	1		C		1

Thesis and free optional courses

Code	Subject	Credit	Hours/week		Examination	Prerequisites	Semester
			Theory	Practice			
TTMBG0701	Thesis 1.	5			T	TTMBG0001 TTMBE0101 TTMBE0102 TTMBE0202 TTMBE0301	5
TTMBG0702	Thesis 2.	5			T	TTMBG0701	6
	Free optional courses	9					

Subjects of Semester 1

TTMBG0001
Basics of mathematics
0+1 classes/week, 0+0 credit, A
Lecturer: Dr. Varga Nóra
Prerequisities: none

Algerbaic transformations. Solution of different type equations, equation systems, inequalities and inequality systems. Basic notions of trigonometry and coordinate geometry.
Compulsory/Recommended Readings:
A. Bérczes and Á. Pintér: College Algebra. University of Debrecen, 2013. http://math.unideb.hu/media/berczes-attila/College-Algebra.pdf
R. D. Gustafson: College algebra and trigonometry. Pacific Grove, Brooks/Cole, 1986.

TTMBE0101, TTMBG0101
Introduction to algebra and number theory
2+3 classes/week, 3+3 credit, C+T
Lecturer: Dr. Pintér Ákos
Prerequisities: none

Relations, algebraic structures, operations and their properties. Divisibility and division with remainder in Z. Greatest common divisor, Euclidean algorithm. Congruence relation and congruence classes in Z, rings of congruence classes. The theorem of Euler-Fermat. Linear conguences. Linear congruence systems, Chinese remainder theorem. Two-variable and multivariate linear Diophantine equations. Peano axioms, N, Z, Q. Complex numbers, operations, conjugate, absolute value. Trigonometric form of complex numbers, theorem of Moivre, n^th roots of complex numbers, roots of unity. Polynomial ring over field. Euclidean division, greatest common divisor. Ring of Z[x], Q[x], R[x], C[x] , absolute value. Fundamental theorem of algebra. Partial fraction expression. Algebraic equaitions, discriminant, resultanat, multiple roots, cubic and quartic equations. Multvariate polynomials, symmetric and elementary symmetric functions, fundamental theorem of symmetric polynomail.
Compulsory/Recommended Readings:
I. Nivan, H. S. Zuckerman, H. L. Montgomery: An introduction to the theory of numbers. John Wiley and Sons, 1991 [1960]. http://www.fuchs-braun.com/media/532896481f9c1c47ffff8077ffffff0.pdf
L. N., Childs:: A concrete introduction to higher algebra. New York, Springer, 2000.

TTMBE0102, TTMBG0102
Linear algebra 1.
2+2 classes/week, 3+2 credit, C+T
Lecturer: Dr. Gaál István
Prerequisities: none

Basic notions in algebra. Determinants. Operations with matrices. Vector spaces, basis, dimension. Linear mappings. Transformation of basis and coordinates. The dimensions of the row space and the column space of matrices are equal. Sum and direct sum of subspaces. Factor spaces. Systems of linear equations. Matrix of a linear transformation. Operations with linear transformations. Similar matrices. Eigenvalues, eigenvectors. Characteristic polynomial. The existence of a basis consisting of eigenvectors.
Compulsory/Recommended Readings:
Paul R. Halmos: Finite dimensional vector spaces, Benediction Classics, Oxford, 2015.
Serge Lang, Linear Algebra, Springer Science & Business Media, 2013.
Howard Anton and Chris Rorres, Elementary Linear Algebra, John Wiley & Sons, 2010.

TTMBE0107, TTMBG0107
Combinatorics and graph theory
3+2 classes/week, 4+2 credit, C+T
Lecturer: Dr. Nyul Gábor
Prerequisities: none

Fundamental enumeration problems: permutations, variations, combinations. Properties of binomial coefficients, binomial and multinomial theorem. Inversions, parity, product of permutations, cycles. Inclusion–exclusion principle and applications. Basic definitions of graph theory. Eulerian trail, Hamiltonian path and cycle. Trees and forests, spanning trees, Prüfer code and Cayley's formula. Bipartite graphs. Plane graphs, dual graph, Euler's formula, planar graphs and their characterization. Vertex and edge colourings of graphs, chromatic number, the five color theorem, chromatic polynomial, chromatic index. Fundamentals of Ramsey theory. Matrices of graphs.
Compulsory/Recommended Readings:
Béla Andrásfai: Introductory Graph Theory, Akadémiai Kiadó, 1977.
N. Ya. Vilenkin: Combinatorics, Academic Press, 1971.
Miklós Bóna: A Walk Through Combinatorics, World Scientific, 2017.

TTMBE0201, TTMBG0201
Sets and functions
2+2 classes/week, 3+2 credit, C+T
Lecturer: Dr. Lovas Rezső
Prerequisities: none

Foundations of set theory. Relations. Equivalence and order relations, functions. Basic notions in partially ordered sets and Tarski's fixed point theorem. Cardinality of sets, Cantor's theorem and the Schröder–Bernstein theorem. Axioms of the real numbers and their corollaries. Notable subsets of the reals: natural numbers, integers, rational and irrational numbers. Uniqueness of the set of real numbers. Existence and uniqueness of the nth root of a nonnegative number. The p-adic represantion of real numbers. Notable inequalities. The field of complex numbers. Cardinality of sets of numbers.
Compulsory/Recommended Readings:
Walter Rudin: Principles of Mathematical Analysis, McGraw-Hill, New York, 1976.

TTMBE0301, TTMBG0301
Geometry 1.
2+2 classes/week, 3+2 credit, C+T
Lecturer: Dr. Vincze Csaba
Prerequisities: none

Absolute Geometry: incidence axioms, ruler postulate, plane separation postulate, protractor postulate and the axiom of congruence. Some representative results in Absolute Geometry: congruence theorems, perpendicular and parallel lines, sufficient conditions for parallelism, inequalities. The Euclidean parallel postulate and some equivalent statements. Introduction to the Euclidean geometry (theorems for parallelograms, Intercept theorem and its relatives, similar triangles). Euclidean plane isometries: three mirrors suffice, the classification theorem. The classification of the Euclidean space isometries. Similarities, the fixpoint theorem and the classification of plane/space similarities. The general notion of congruence and similarity. Geometric measure theory: area of polygons, Jordan measure, the area of a circle. The axioms of measuring volumes, the volume of a sphere . The perimeter of a circle, the area of a sphere.
Compulsory/Recommended Readings:
Csaba Vincze and László Kozma: College Geometry, TÁMOP-4.1.2.A/1-11/1-2011-0098, http://www.tankonyvtar.hu/hu/tartalom/tamop412A/2011-0098_college_geometry/index.html
John Roe: Elementary Geometry, Oxford University Press, 1993.

TTMBG0601
Introduction to informatics
0+3 classes/week, 0+2 credit, T
Lecturer: Dr. Tengely Szabolcs
Prerequisities: none

An introduction to LaTeX, a document preparation system for high-quality typesetting. Typesetting of complex mathematical formulas in LaTeX.
Presentation creation using the Beamer class. Writing a formal or business letter in LaTeX. Using the moderncv class for typesetting curricula vitae.
The memoire class, a tool to creat BSc/MSc thesis. Introduction to SageMath, a computer algebra package. The Jupyter Notebook interface and the SageMathCloud.
Basic tools, assignment, equality, and arithmetic. Boolean expressions, loops, lists and sets. Writing functions in SageMath.
Compulsory/Recommended Readings:
T. Oetiker: The Not So Short Introduction to LaTeX
Gregory Bard: SageMath for Undergraduates (http://www.gregorybard.com/Sage.html)

TTTBE0030
European Union studies
1+0 classes/week, 1+0 credit, C
Lecturer: Dr. Teperics Károly
Prerequisities: none

Aim of the course: The objective of the course is to provide information about the theoretical background of integrations in general, the history of the European Union and its role in the world economy.
Topic: The process of reformation of the integration is going to be shown by the presentment of the institutions of the European Union. The process of enlargement, the characteristics of the fifth phase of the enlargement and the EU membership of Hungary is going to be emphasized especially.
Compulsory/Recommended Readings:
Farkas B., Várnay E. (2005): Bevezetés az Európai Unió tanulmányozásába, JATEPRESS Kiadó, Szeged
Palánkai T. (2004): Az európai integráció gazdaságtana, Aula Kiadó, Budapest
Horvath Z.: Kézikönyv az Európai Unióról – Akadémiai Kiadó, Budapest, 2005.

TTTBE0040
Basic environmental studies
1+0 classes/week, 1+0 credit, C
Lecturer: Dr. Nagy Sándor Alex
Prerequisities: none

Aims of the course: The student should acquire the more important natural science and social science connections of the based on ecology and focused on living organisms. The student have knowledge based on ecology and environmental elements of the environmental sciences. The student should be able to understand the necessity to recognise the sustainable development, knowing the history of environment protection and nature conservation.
The course involves: Environmental sciences and the ecological principles. Terminological system of our environment. Environmental sciences and interdisciplinary. Challenge for science. The principle of precaution. Environmental problems. Natural environment. The surface of the Earth. Soil, the hydrosphere, the atmosphere.
The history of the natural conservation and the environmental protection; the sustainable development. Sustainable development. The economics of the human populations and the environmental sources. Limits of the growth. Human demography. The future of human populations. Resources and reserves. The soil as natural resource and the sustainable agriculture. The water supply and the water as power source. Biological resources. The effect of the human activity on the natural environment. The pollution of the atmosphere. Water pollution. The environmental pollution of industry. Technological forecast and the environment. Sustainable development: as a challenge
Compulsory/Recommended Readings:
Jackson, A,R.W., Jackson, J.M. 1996: Environmental Science. The natural environment and

human impact. Longman, Singapore.
Brundtland, G.H. (Chair) 1987: Our common future. Oxford: Oxford University Press.
Cunningham, W.P. & Saigo, B.W. 1995: Environmental Science. A global concern. Dubuque: Wm.C. Brown Publishers.