DEPARTMENT OF MATHEMATICS UNDERGRADUATE CURRICULUM

FIRST YEAR

First Semester

MATH 111	Analytic Geometry	(3-0)3 / ECTS:5
MATH 131	Fundamentals of Mathematics	(4-2)5 / ECTS:7
MATH 151	Calculus I	(4-2)5 / ECTS:7
PHYS 101	General Physics I	(4-0)4 / ECTS:5
PHYS 111	General Physics Lab I	(0-2) 1/ECTS: 2
ENG 101	Development of Reading and Writing Skills I	(3-0)3 / ECTS:3
OHS 101	Occupational Health and Safety I	(1-0)1/ECTS: 1

Total Credits:22 Total ECTS: 30

Second Semester

MATH 132	Introduction to Discrete Mathematics	(3-2)4 / ECTS:6
MATH 152	Calculus II	(4-2)5 / ECTS:7
CENG 113	Programming Basics	(3-2)4 / ECTS:6
PHYS 102	General Physics II	(4-0)4 / ECTS:5
PHYS 112	General Physics Lab II	(0-2) 1/ECTS: 2
ENG 102	Development of Reading and Writing Skills II	(3-0)3 / ECTS:3
GCC 101	Career Planning and Development	(0-2)NC/ECTS:2
OHS 102	Occupational Health and Safety II	(1-0)1/ECTS: 1

Total Credits: 22 Total ECTS: 32

SECOND YEAR

Third Semester

MATH 251	Vector Analysis	(4-2)5 / ECTS:6
MATH 257	Differential Equations	(4-0)4 / ECTS:6
MATH 261	Linear Algebra I	(3-2)4 / ECTS:6
HIST 201	Principles of Atatürk I	(2-0)NC / ECTS:2
TURK 201	Turkish Language I	(2-0)NC / ECTS:2
Xxxxxxx	Technical Elective	(3-0)3 / ECTS: 5
Xxxxxxx	Non-Technical Elective	(3-0)3 / ECTS:3

Total Credits:19 **Total ECTS:**30

Fourth Semester

MATH 202	Scientific Computing	(2-2)3 / ECTS:6
MATH 252	Analysis	(4-0)4 / ECTS:6
MATH 262	Linear Algebra II	(3-2)4 / ECTS:6
HIST 202	Principles of Atatürk II	(2-0)NC / ECTS:2
TURK 202	Turkish Language II	(2-0)NC / ECTS:2
Xxxxxxxx.	Technical Elective	(3-0) 3/ ECTS: 5
Xxxxxxxx.	Non-Technical elective	(3-0)3 / ECTS:3

Total Credits: 17 **Total ECTS:**30

THIRD YEAR

Fifth Semester

MATH 355	Partial Differential Equations	(3-2)4 / ECTS:8
MATH 361	Abstract Algebra	(4-2)5 / ECTS:10
MATH 366	Number Theory	(3-0)3 / ECTS:6
Xxxxxxxx.	Technical elective	(3-0)3 / ECTS:6
		Total Credits: 15 **Total ECTS:**30

Sixth Semester

MATH 332	Probability and Statistics	(4-2)5 / ECTS: 8
MATH 352	Complex Analysis	(4-2)5 / ECTS:10
Xxxxxxxx.	Math Elective	(3-0)3 / ECTS:6
Xxxxxxxx.	Technical Elective	(3-0)3 / ECTS:6
		Total Credits:16 **Total ECTS:**30

FOURTH YEAR

Seventh Semester

MATH 415	Mathematical Research Project I	(2-0)NC / ECTS:6
MATH 452	Functional Analysis	(3-0)3/ECTS:6
Xxxxxxxx.	Technical elective	(3-0)3 / ECTS:6
xxxxxxxx.	Technical elective	(3-0)3 / ECTS:6
xxxxxxxx.	Non Technical elective	(3-0)3 / ECTS:3
xxxxxxxx.	Non Technical elective	(3-0)3 / ECTS:3
		Total Credits:15 Total ECTS:30

Eighth Semester

MATH 416	Mathematical Research Project II	(2-0)NC / ECTS:15
xxxxxxxx.	Technical elective	(3-0)3 / ECTS:6
xxxxxxxx.	Technical elective	(3-0)3 / ECTS:6
xxxxxxxx.	Non Technical elective	(3-0)3 / ECTS:3
		Total Credits:9 **Total ECTS:**30

Total Credit: 135
Total ECTS: 242

Math Elective: Elective course from Mathematics Department

Technical Elective: Any core or elective course with at least 3 credits from the Departments of Engineering or Science Faculty **(including Math Elective courses)**

A Non Tecnical Elective: Any course from the Department of General Culture, School of Foreign Languages or Faculty of Architecture

Core Courses

MATH 111 Analytic Geometry	(3-0)3/ECTS:5
MATH 131 Fundamentals of Mathematics	(4-2)5 ECTS:7
MATH 132 Introduction to Discrete Mathematics	(3-2)4 ECTS:6
MATH 151 Calculus I	(4-2)5 ECTS: 7
MATH 152 Calculus II	(4-2)5 ECTS: 7
MATH 202 Scientific Computing	(2-2)3 ECTS:6
MATH 251 Vector Analysis	(4-2)5 ECTS:6
MATH 252 Analysis	(4-0)4 ECTS: 6
MATH 257 Differential Equations	(4-0)4 ECTS: 6
MATH 261 Linear Algebra I	(3-2)4 ECTS:6
MATH 262 Linear Algebra II	(3-2)4 ECTS:6
MATH 332 Probability and Statistics	(4-2)5 ECTS: 8
MATH 352 Complex Analysis	(4-2)5 ECTS: 10
MATH 355 Partial Differential Equations	(3-2)4 ECTS: 8
MATH 366 Number Theory	(3-0)3/ECTS:6
MATH 361 Abstract Algebra	(4-2)5 ECTS: 10
MATH 415 Mathematical Research Project I	(2-0)NC ECTS: 6
MATH 416 Mathematical Research Project II	(2-0)NC ECTS: 15
MATH 452 Functional Analysis	(3-0)3/ECTS:6

MATH Elective Courses

MATH 200 Under Graduate Seminar	(3-0)3 ECTS 6
MATH 201 Introduction to Mathematical Programming	(2-2)3 ECTS 6
MATH 240 Analytical Mechanics	(3-0)3 ECTS 6
MATH 260 Math For Sustainability	(3-0)3 ECTC 6
MATH 301 Dynamical Systems	(3-0)3 ECTS: 6
MATH 303 History Of Mathematical Concepts I	(3-0)3 ECTS: 6
MATH 304 History Of Mathematical Concepts II	(3-0)3 ECTS: 6
MATH 307 Introduction to Graph Theory	(3-0)3 ECTS: 6
MATH 308 Introduction to Combinatorics	(3-0)3 ECTS: 6
MATH 309 Olympiad Mathematics: Theory and Applications	(3-0)3 ECTS: 6
MATH 311 Coding theory	(3-0)3 ECTS: 6
MATH 312 Computational Mathematics and Algorithms	(2-2)3 ECTS: 6
MATH 313 Introduction to Cryptography	(3-0)3 ECTS:6
MATH 330 Trending Mathematical Algorithms	(2-2)3 ECTS:6
MATH 333 Introduction to Mathematical Modeling	(3-0)3 ECTS: 6
MATH 334 Introduction to Wavelets and Applıcations	(3-0)3 ECTS: 6
MATH 335 Mathematical Image Deblurring	(3-0)3 ECTS: 6
MATH 338 Mathematics for Machine Learning	(3-0)3 ECTS:6
MATH 341 Advanced Mathematics Internship	(0-6)3 ECTS: 6
MATH 342 Mathematics Internship	(0-1)NC ECTS: 6
MATH 368 An Introduction to Mathematical Control Theory	(3-0)3 ECTS: 6
MATH 372 Differential Geometry	(3-0) 3 ECTS: 6

MATH 381 Numerical Analysis	(3-0) 3 ECTS: 6
MATH 382 Numerical Analysis II	(3-0)3 ECTS:6
MATH 385 Special Functions of Applied Mathematics	(3-0)3 ECTS: 6
MATH 386 Fluid Dynamics	(3-0)3 ECTS: 6
MATH 387 An Introductıon to Topology of Surfaces	(3-0)3 ECTS: 6
MATH 389 Introduction to Commutative Ring Theory	(3-0)3 ECTS: 6
MATH 401 Quantum Mechanics	(3-0)3 ECTS: 6
MATH 403 Combinatorial Design Theory	(3-0)3 ECTS: 6
MATH 404 Quantum Computations and Information	(3-0)3 ECTS: 6
MATH 405 Variational Analysis	(3-0)3 ECTS: 6
MATH 406 Mathematics of Public Key Cryptography	(3-0)3 ECTS: 6
MATH 407 Conformal Mappings	(3-0)3 ECTS: 6
MATH 408 Advanced Topics in Graph Theory	(3-0)3 ECTS: 6
MATH 409 Advanced Topics in Combinatorics	(3-0)3 ECTS: 6
MATH 410 Green's Functions	(3-0)3 ECTS: 6
MATH 411 Mathematical Optimization	(3-0)3 ECTS: 6
MATH 412 Hyperbolic Geometry	(3-0)3 ECTS: 6
MATH 413 Linear and Nonlinear Waves	(3-0)3 ECTS: 6
MATH 414 Introduction to Integral Equations	(3-0)3 ECTS: 6
MATH 422 Introduction to Abelian Groups	(3-0)3 ECTS: 6
MATH 430 Contemporary Applications of Mathematics	(2-2)3 ECTS: 6
MATH 432 Analysis of Symmetric Encryption and Hash Functions	(3-0)3 ECTS: 6
MATH 438 Mathematical Foundations of Deep Learning	(3-0) ECTS: 6
MATH 440 Knot Theory and Its Applications	(3-0)3 ECTS: 6
MATH 441 Introduction to Geometric Topology	(3-0)3 ECTS: 6
MATH 443 Introduction to Analytic Number Theory	(3-0)3 ECTS: 6
MATH 444 Introduction to Modules and Rings	(3-0)3 ECTS 6
MATH 445 Mathematical Aspects of Blockchain Technologıes	(3-0)3 ECTS 6
MATH 446 Supplementary Curricular Courses	(3-0)3 ECTS 6
MATH 447 Entrepreneurship Education	(3-0)3 ECTS 6
MATH 450 Scale Invariance and Dimensional Analysis	(3-0)3 ECTS: 6
MATH 451 Mathematics and Technology	(3-0)3 ECTS: 6
MATH 453 Introduction to Generalized Functions	(3-0)3 ECTS: 6
MATH 455 Control of Infinite Dimensional Systems	(3-0)3 ECTS: 6
MATH 456 Galois Theory	(3-0)3 ECTS: 6
MATH 457 Methods of Mathematical Economics	(3-0)3 ECTS:6
MATH 481 Differential Equations with Numerical Methods	(2-2)3 ECTS: 6
MATH 482 Numerical Solutions of Linear Integral Equations	(3-0)3 ECTS: 6
MATH 494 Mathematical Methods for Data Analysis	(3-0)3 ECTS: 6
MATH 499 Cooperative Education Course	(0-12)6 ECTS: 6

Courses for other departments

MATH 101 Precalculus	(2-0) NC/ECTS:2
MATH 121 Basic Mathematics I	(4-0)4/ECTS:4
MATH 141 Basic Calculus I	(3-2)4/ECTS:5

MATH 142 Basic Calculus II	(3-2)4/ECTS:6
MATH 144 Finite Mathematics	(3-0)3/ECTS:5
MATH 145 Calculus for Engineering and Science I	(4-2)5/ECTS:7
MATH 146 Calculus for Engineering and Science II	(4-2)5/ECTS:8
MATH 241 Calculus III	(3-2)4/ECTS:5
MATH 255 Differential Equations	(4-0)4/ECTS:6
MATH 265 Basic Linear Algebra	(3-0)3/ECTS:4

Courses Description

MATH 101 Precalculus **(2-0)NC/ECTS: 2**

Functions and their inverses, operations with functions and graphing techniques, polynomial functions, rational functions, exponential and logarithmic functions, trigonometric functions, trigonometric identities, trigonometric equations, systems of equations, inequalities, and solving techniques.

MATH 111 Analytic Geometry **(3-0)3/ECTS:5**

Vectors in Plane and in Space. Coordinate systems. Basis Vectors. Inner Product. The Straight Line. Distance between two points. Distance from Point to Line. Circles. Spheres. Planes. Distance from Point to Plane. The angle between two lines. Cross Product. Triple scalar Product. Distance between two lines. Second Order Curves. Conic Sections. Second Order Surfaces. Transformations of Coordinates.

MATH 121 Basic Mathematics I **(4-0)4/ECTS:4**

Functions, Limits and continuity, Derivatives, Extreme values, the Mean Value Theorem and its applications, Graphing, Integration, Fundamental theorem of Calculus, L'Hopital's Rule, Techniques of integration, and Area between two curves.

MATH 131 Fundamentals of Mathematics **(4-2)5/ECTS:7**

Symbolic Logic, Logical Operations. Quantifiers, Demorgan's Law. Sets and sets operations. Direct Proofs, Proof by Contradiction. Existence Proofs. Functions, Injections and Surjections, bijections. Cardinality, Countability. Countable sets, Uncountability of the reals. Relations, equivalence relations, Partitions. Ordered sets, Partial order, total order. Well-Ordering Principle, Zorn's Lemma, Axiom of Choice, Induction Principle and its Applications, Basic algebraic structures: Binary Operations.

MATH 132 Introduction to Discrete Mathematics **(3-2)4/ECTS:6**

Division Algorithm, The Fundamental Theorem of Arithmetic, The Euclidean Algorithm, Counting Problems, The Binomial Theorem, Linear Recurrence Relations, Inclusion and Exclusion, Graph Terminology, The Degree of a Graph Vertex, The Handshaking Lemma, Graphs with Matrices, Eulerian and Hamiltonian paths in a graph.

MATH 141 Basic Calculus I **(3-2)4/ECTS:5**

Functions and Their Graphs, Limits and Limit Rules, Continuity, Derivatives, Applications of Derivatives, The Intermediate Value Theorem, The Mean Value Theorem, Concavity and Curve Sketching, L'Hospital's Rule, The Definite Integral, Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Area Between Curves.

MATH 142 Basic Calculus II **(3-2)4/ECTS:6**

Application of Integrals, Techniques of Integration and Improper Integrals, Sequences and Series, Partial Derivatives, An Introduction to Double Integrals.

MATH 144 Finite Mathematics (3-0)3 ECTS:5

Linear systems of equations. Elementary operations on a linear system. Gauss Elimination Method. Matrices. Multiplication of Matrices. Transpose. Rank. Elementary Matrices. The inverse of a Matrix. LU-Decomposition. Determinants. Properties of Determinant. Cramer's Rule. Eigenvalues and Eigenvectors. Linear Combination of Vectors. Graphs. Incidence and Adjacency Matrix. Bipartite graphs. Paths. Cycles. Connectivity. Trees. Spanning Trees. Planar Graphs. Graph coloring. Isomorphism.

MATH 145 Calculus for Engineering and Science I (4-2)5/ECTS:7

Functions, Limits and Continuity, Differentiation, Applications of Derivatives; Extreme values of functions, the mean value theorem, monotonic functions, and the 1st derivative test, concavity, and curve sketching. Optimization problems, indeterminate forms, and L'Hopital's rule, antiderivatives, Integration; estimating with finite sums, the definite integral, the fundamental theorem of calculus, the substitution rule, Applications of Definite Integrals, Transcendental functions, Techniques of Integration, Conic sections and polar coordinates.

MATH 146 Calculus for Engineering and Science II (4-2)5/ECTS:8

Infinite sequences and series, power series, Taylor and Maclaurin series. Vectors and the geometry of space; the dot product, the cross product. Vector-valued functions and motion in space. Partial derivatives; functions of several variables, limits and continuity in higher dimensions, directional derivatives and gradient vectors, extreme values and saddle points, and Lagrange multipliers. Multiple integrals; double integrals, double integrals in polar form, triple integrals in rectangular, cylindrical, and spherical coordinates. Integration in vector fields; line integrals, vector fields, path independence, Green's theorem, surface area and surface integrals, Stokes' theorem, and the Divergence theorem.

MATH 151 Calculus I (4-2)5/ECTS:7

Functions and their graphs. Trigonometric and Exponential functions, inverse functions. Limit and continuity of a function of a single variable. Introduction to the derivative of a function, implicit differentiation and chain rule, the basic theorems of differential calculus: Intermediate Value, Extreme Value, and the Mean Value Theorems, applications of derivative: graph sketching and problems of extrema, related rate, and optimization problems.

MATH 152 Calculus II (4-2)5/ECTS:7

The Riemann Integral, Mean Value Theorem for integrals, Fundamental Theorem of Calculus, Techniques to evaluate anti-derivative, and various geometric and physical applications. Sequences, improper Integrals, infinite series, power series, and Taylor's series with applications.

MATH 200 Under Graduate Seminar (3-0)3/ECTS 6

The student and the instructor choose the study topic from popular mathematical journals or some interesting subjects not covered in the undergraduate curriculum.

MATH 201 Introduction to Mathematical Programming (2-2)3/ECTS:6

LaTeX environment, writing equations in LaTeX, inserting tables and figures into the documents, and cross-referencing LaTeX. Creating a table of contents and bibliography in LaTeX, preparing presentations in LaTeX, Introduction of IPython interface and Python libraries (Sympy, numpy, etc), fundamentals of mathematical operations in Python/IPython, calculus, and linear algebra applications with Python/IPython. Plotting with Python/IPython, Programming with Python/IPython, Mathematica interface and fundamentals of Mathematica, Calculus and Linear Algebra applications with Mathematica, Mathematica as a programming language, file operations and plotting in Mathematica.

MATH 202 Scientific Computing (2-2)3/ECTS:6

Matlab/Octave basics, creating arrays, using script files, 2- dimensional plots, programming in Matlab/Octave, Operators, Conditional Statements and Loops, defining the function and creating function files, applications of functions, 3-dimensional plots, transferring and solving various mathematical problems to computer environment with Matlab/Octave. Symbolic computations with Matlab/Octave.

MATH 240 Analytical Mechanics (3-0)3 ECTS:6

The geometry of motion. The Newton equations of motion. Generalized coordinates. Calculus of variations and the principle of least action. The Euler-Lagrange equations. Conservation laws. Energy. Momentum. Centre of mass. Angular momentum. Integration of the equations of motion. Motion in one dimension. The reduced mass. Motion in a central field. Small oscillations. Free oscillations in one dimension. Forced oscillations. Damped oscillations. The canonical equations. Hamilton's equations.

MATH 241 Calculus III (3-2)4/ECTS:5

Vector-Valued Functions and Space Curves, Calculus of Vector-Valued Functions, Motion in Space, Multiple Integrals over Rectangular Regions, Integrals in Polar, Cylindrical, and Spherical Coordinates, Change of Variables in Multiple Integrals, Vector Fields, Divergence and Curl, Line Integrals, Properties and Applications of Line Integrals, Surface Integrals, Conservative Fields, Fundamental Theorems of Vector Calculus: Green's Theorem, Stoke's Theorem, Divergence Theorem.

MATH 251 Vector Analysis (4-2)5/ECTS:6

Functions of several variables. Limits and continuity. Partial derivatives. Derivatives of composite functions. Jacobian matrix. Implicit functions and implicit function theorems. The directional derivatives. Higher order derivatives. Maxima and minima of functions of several variables. Lagrange multipliers method. Multiple integrals. Polar, Cylindrical, and Spherical coordinates. Change of variables in Double and triple integrals. Parametrization of paths and surfaces. Vector Fields, divergence, and curl. Line integrals. Surface integrals. Related theorems to line and surface integrals. Green's Theorem. Stokes Theorem. Divergence Theorem.

MATH 252 Analysis (4-0)4/ECTS:6

Real numbers, completeness of R, the convergence of sequences, Cauchy sequences, open and closed sets compact sets, Heine-Borel and Bolzano-Weierstrass Theorems, connected and path-connected sets, continuous mappings, function sequences, pointwise and uniform convergence, function series, the inverse function theorem, implicit functions and the implicit function theorem**.**

MATH 255 Differential Equations (4-0)4/ECTS:6

First-order equations and various applications. Higher order linear differential equations. Power series solutions: ordinary and regular singular points. The Laplace transform solution of initial value problems. Systems of linear differential equations: solutions by operator method, by Laplace transform.

MATH 257 Differential Equations (4-0)4/ECTS:6

Introduction to Differential Equations, Solutions to First-Order Differential Equations and Initial Value Problems, Direction Fields and Autonomous ODE, Basic Theory of Second and Higher-Order Linear Differential Equations, Methods for Solving Linear Homogeneous and Nonhomogeneous ODE, Modeling with Second and Higher-Order Differential Equations, Series Solutions of Linear Equations, The Laplace Transform Approach to Linear ODE, Basic Theory of Systems of Linear First-Order Differential Equations, Solving Homogeneous and Nonhomogeneous Linear Systems.

Math 260 Math for Sustainability **(3-0)3/ECTS:6**

Introduction to Sustainability, Sustainability Goals, Algebra, and Population Growth, Set Theory and Renewable Energy, Probability and Organic Agriculture, Linear Regression and Correlation, Networks and Connections, Green Transportation, Geometry and Natural Buildings, Calculus and Social Justice, Energy Stocks, Flows and Equilibrium**.**

MATH 261 Linear Algebra I **(3-2)4/ECTS:6**

Matrices. Elementary Row Operations. Systems of Linear Equations. Gauss Ellimintaion Method. Matrix Algebra. Square and Invertible Matrices. Techniques for finding matrix inverse. Determinants. Cramer's Rule. LU and Cholesky decompositions. Vector Spaces. Subspaces. Linear independence. Basis and Dimension. Rank-Nullity Theorem. Eigenvalues and Eigenvectors. Diagonalization of Matrices. Similar Matrices. Application to Difference and Differential Equations. Jordan Normal Form.

MATH 262 Linear Algebra II **(3-2)4/ECTS:6**

Inner Product Spaces. Orthonormal Bases. Orthogonal Projections. Gram-Shmidt Process. Best Approximation. Least Squares. Orthogonal Matrices. Orthogonal Diagonalization. Real Quadratic Forms. Optimization Using Quadratic Forms. Hermitian, Normal, and Unitary Matrices. Unitary Diagonalization. General Linear Transformations. Matrix Representation of Linear Transformations. Singular Value Decomposition. Polar Decomposition. Linear Programming. Selected Applications.

MATH 265 Basic Linear Algebra **(3-0)3/ECTS:4**

Matrices, determinants, and systems of linear equations. Gaussian elimination. LU Decomposition. Vector spaces; subspaces, sum, and direct sums of subspaces. Linear dependence, bases, dimension. rank and nullity, change of basis, canonical forms, inner product, Gram-Schmidt orthogonalization process, QR decomposition. Eigenvalues, eigenvectors, diagonalization, similarity. Quadratic Forms. Complex vector spaces, Complex eigenvalues, Unitary and Hermitian Matrices. Least-squares.

MATH 301 Dynamical Systems **(3-0)3/ECTS:6**

One-dimensional dynamical systems, fixed points, and their stabilities. The population growth model, Linear Stability analysis, Existence and Uniqueness of differential equations. Potential functions. Bifurcations, Two dimensional dynamical systems, classification of linear systems, Phase plane, fixed points and linearization, conservative systems, reversible systems, pendulum, limit cycles, Gradient systems, Liapunov functions, Poincare-Bendixson theorem.

MATH 303 History of Mathematical Concepts I **(3-0)3/ECTS:6**

Origins of number and geometry. Egypt and Mesopotamia. Ionia and Pithagoreans. The Heroic Age. Paradoxes of Zeno. The Age of Plato and Aristotle. Euclid of Alexandria. Elements. Archimedes. Apollonius of Perga. The Conics. The Arithmetical of Diophantus. China and India. Ramanujan. Algebra and Arabs. Europe in the Middle Ages. Solution of a cubic equation.

MATH 304 History of Mathematical Concepts II **(3-0)3/ECTS:6**

The Renaissance. Cardano. Solution of the cubic equation. Complex numbers. The invention of logarithms.

Fermat and Descartes. Analytic geometry. Number theory. Probability. The limit concept. Newton and Leibnitz. The Principia. Probability and infinite series. Development of calculus. Age of Euler. D'Alembert. Lagrange. Monge. Laplace. Gauss and Cauchy. Noneuclidean geometry. Lobachevskiy. Abel, Jacobi, Galois. Projective geometry. Riemannian geometry. Felix Klein. Analysis. Riemann. Mathematical physics. British Algebra. Algebraic geometry. Poincare and Hilbert. Topology. The aspect of the Twentieth Century.

MATH 307 Introduction to Graph Theory (3-0)3/ECTS:6

Graph definitions and models. Representation of graphs and morphisms. Paths, cycles, degree sequences, special graphs. Bipartite graphs, trees, and distance, spanning trees. Directed graphs. Matchings and factors. Independent sets and cliques, covers, and dominating sets. Maximum bipartite matching. Hall matching condition, min-max theorems. Connectivity and cuts. Menger's theorem and k-connected graphs. Upper bounds and Brooks' theorem. Planar graphs, embeddings, and Euler's formula. Colorings of planar graphs.

MATH 308 Introduction to Combinatorics (3-0)3/ECTS:6

Counting methods and techniques; pigeonhole principle; generating functions; sum and product lemmas; formal power series; binomial theorem; recurrence relations and their solutions; binary strings; integer partitions.

MATH 309 Olympiad Mathematics: Theory and Applications (3-0)3/ECTS:6

Divisibility of integers. GCD and LCM. Euclidean algorithm. Congruences. Solution of linear congruences. Chinese remainder theorem. Fermat's little theorem. Euler's function. Euler's theorem. Quadratic and cubic residues. Primitive roots. Index with respect to a prime. Diophantine equations. Two basic counting principles. Arrangements and selections. Distributions. The pigeonhole principle. Inclusion–Exclusion principle. The invariance principle. Coloring proofs. Polynomials, roots of polynomials, and factorization. Bounds for real roots and related theorems. Intermediate value theorem. Arithmetic, geometric, and harmonic means. Cauchy–Schwarz inequality. Chebyshev's inequality. Sequences and series. Extreme values of functions.

MATH 311 Coding theory (3-0)3/ECTS:6

Introduction and application of error-correcting codes. Fundamental concepts. Irreducible polynomials. Finite fields and minimal polynomials. Introduction to linear codes. Generator matrix and dual codes. Hamming codes and perfect codes. Standard array decoding. Reed-Muller, self-dual, and binary Golay codes. Introduction to cyclic codes. Rings, ideals, and cyclic subspaces. Generator matrices and parity check matrices for cyclic codes. BCH codes. Reed-Solomon codes.

MATH 312 Computational Mathematics and Algorithms (2-2)3/ECTS:6

Algorithms on integers. Polynomial algorithms. Fast Fourier Transform. Primality testing and integer factorization. Algortihms on matrices. Geometric algorithms. Graph algorithms.

MATH 313 Introduction to Cryptography (3-0)3/ECTS:6

The fundamental concept and the mathematical infrastructure of cryptology. Several cryptographic algorithms and protocols, historical ciphers, block ciphers, and analysis, DES and AES, stream ciphers and analysis, keystream generators, public key cryptosystems, RSA and LLL algorithms, hash functions and message authentication codes (MACs), digital signature algorithms, DSA and ElGamal signature, Diffie Hellman key exchange, cryptographic protocols, and key management.

MATH 330 Trending Mathematical Algorithms (2-2)3/ECTS:6

Introduction to Data Analysis, Programming tools for Machine Learning and Data Analysis, Principal Component Analysis, Singular Value Decomposition and its applications, Bivariate Linear Regression, Binary Logistic

Regression, Stochastic Models: Markov Chains, Page Ranking Algorithm, Probabilistic Classification: Naïve Bayes Classifier, Testing Performance and Accuracy of the Computational Models, K-Nearest Neighbor, Support Vector Machines.

MATH 332 Probability and Statistics (4-2)5/ECTS: 8

Basics of statistical computer languages, Random Variables, Mean, Variance, Binomial and Poisson distributions, Continuous distributions, Central Limit Theorem and applications, Exploratory data analysis, Point Estimation, Interval Estimation, Hypothesis testing, Linear and Logistics Regression, Analysis of Variance

MATH 333 Introduction to Mathematical Modelling (3-0)3/ECTS:6

Modeling with discrete dynamical systems. The modeling process, proportionality, and geometric similarity. Model fitting. Experimental modeling. Simulation modeling. Discrete probability modeling. Discrete optimization modeling, linear programming, and numerical search methods. Dimensional analysis and similitude. Graphs of functions as models. Modeling with systems of differential equations. Continuous optimization modeling.

MATH 334 Introduction to Wavelets and Applications (3-0)3/ECTS: 6

Continuous and discrete Fourier transform. Short-Time Fourier Transform. Continuous wavelet transform. Discrete wavelet transform. Daubechies wavelets. Designing orthogonal wavelet systems. Orthonormality of translates of scaling functions. Orthonormality of scaling and wavelet functions. Approximation conditions (Smoothness conditions). Discrete wavelet transform and relation to filter banks. Signal decomposition (Analysis), Relation with filter banks. Down-sampling, up-sampling, and filtering. Multi-Resolution Analysis (MRA). Biorthogonal Wavelets. B-Splines. Applications of wavelets: Applications of wavelets in signal and image processing and other related engineering fields.

MATH 335 Mathematical Image Deblurring (3-0)3/ECTS:6

The Image Deblurring Problem, A First Attempt at Deblurring, Deblurring Using a General Linear Model, Manipulating Images in MATLAB, The Blurring Function: Obtaining the PSF, Noise, Boundary Conditions, Structured Matrix Computations: 1D and 2D Problems, BCCB Matrices, BTTB + BTHB+BHTB + BHHB Matrices, Kronecker Product Matrices, Creating Realistic Test Data, Introduction to Spectral Filtering, SVD Analysis, The SVD Basis for Image Reconstruction, The DFT and DCT Bases, The Discrete Picard Condition, Regularization by Spectral Filtering, Implementation of Filtering Methods, Regularization Errors and Perturbation Errors, Color Images, A Blurring Model for Color Images, Tikhonov Regularization Revisited, Working with Partial Derivatives.

MATH 338 Mathematics for Machine Learning (3-0)3/ECTS:6

Computer implementations of linear algebra, analytic geometry, matrix decomposition, vector calculus, probability, optimization, data analysis, regression analysis, and dimension reduction.

MATH 341 Advanced Mathematics Internship (0-6)3/ECTS:6

It is a technical elective mathematics course during which the student performs work at an industrial research laboratory or at a university. The consent of the student's advisor in the Mathematics Department is required for enrollment in this course. The minimum workload is 150 hours. At the end of the internship, the student will prepare a report based on the work performed and the results obtained.

MATH 342 Mathematics Internship (0-1)NC/ECTS:6

An elective mathematics course during which the student works at an industrial research laboratory or at a university. The minimum workload is 150 hours.

MATH 352 Complex Analysis (4-2)5/ECTS:10

Analytic functions. Cauchy-Riemann equations. Harmonic functions. Elementary functions. The logarithmic function and its branches. Contour Integrals and Cauchy's theorem. Cauchy integral formula. Liouville's theorem and the fundamental theorem of algebra. Maximum moduli of functions. Laurent's series and classification of singularities. Calculus of residues. Laplace's equation.

MATH 355 Partial Differential Equations (3-2)4/ECTS:8

First-order linear and quasilinear PDE's. Method of characteristics. Classification of second-order linear partial differential equations. The Cauchy problem. Well-posedness. Eigenvalue problems. Fourier Transform and Convolution. The classical wave equation- D'alambert solution of the Cauchy problem. Solution by Fourier transform. Wave equation on the half line. Reflection method. Wave equations on bounded intervals. Separation of variables method. The Heat equation on the real line and the half line. Solution by Fourier transform. The Heat equation on a bounded interval. Weak maximum principle. Dirichlet and Neumann problems for the Laplace equation. The Laplace equation in polar coordinates. Poisson's formula. The Laplace equation in Higher dimensions. Mean value property and the maximum principle.

MATH 361 Abstract Algebra (4-2)5/ECTS:10

Groups and subgroups. Cosets. Theorem of Lagrange. Homomorphisms. Factor groups. Rings, fields, and integral domains. Rings of polynomials. Factor rings. Ideals. Prime and maximal ideals. Unique factorization domains. Euclidean domains. Principal ideal domains. Field extensions. Finite fields.

MATH 366 Number Theory (3-0)3/ECTS:6

Pythagorean Triples. Sums of Higher Powers and Fermat's Last Theorem. Divisibility and Greatest Common Divisor. Factorization and Fundamental Theorem of Arithmetic. Congruences, Powers, Fermat's Little Theorem, and Euler's Formula. Chinese Remainder Theorem. Prime Numbers, Counting Primes. Mersenne Primes and Perfect Numbers. Powers, Roots, and Codes. Primality Tests. Euler's Phi Function and Sums of Divisors. Primitive Roots and Indices. Which Numbers are Sums of Two Squares? Continued Fractions, Square Roots, and Pell's Equation. Generating Functions. Sums of Powers. Cubic curves and Elliptic Curves.

MATH 368 An Introduction to Mathematical Control Theory (3-0)3/ECTS:6

State Space Fundamentals, Reachability, and Controllability, Detectability, and Observability, Minimal Realizations, BIBO and Asymptotic stability, Design of Linear State Feedback Control Laws, Observers, and Dynamic Feedback.

MATH 372 Differential Geometry (3-0)3/ECTS:6

General concepts of geometry. Coordinates in Euclidean space. Riemannian metric. Pseudo-Euclidean space and Lobachevsky geometry. Flat curves. Space curves. The theory of surfaces in three-dimensional space. The concept of area. Curvature. The second fundamental form. Gaussian curvature. Invariants of a pair of quadratic forms. Euler's theorem. Complex analysis and geometry. Conformal transformations. Isothermal coordinates. The concept of a manifold. Geodesics.

MATH 381 Numerical Analysis (3-0)3/ECTS:6

Convergence, stability, error analysis, and conditioning. Solving systems of linear equations: The LU and Cholosky factorization, pivoting, error analysis in Gaussian elimination. Matrix eigenvalue problem, power method, orthogonal factorizations, and least squares problems. Solutions of nonlinear equations. Bisection, Newton s, secant, and fixed point iteration methods.

MATH 382 Numerical Analysis II **(3-0)3/ECTS:6**

Numerical methods for solving systems of nonlinear equations, optimization, curve fitting, numerical solution of ODE, eigenvalue-eigenvector problem.

MATH 385 Special Functions of Applied Mathematics **(3-0)3/ECTS:6**

Gamma and Beta functions. Pochhammer s symbol. Hypergeometric series. Hypergeometric differential equation. Ordinary and confluent hypergeometric functions. Generalized hypergeometric functions. The contiguous function relations. Orthogonal polynomials. Bessel function. The functional relationships. Bessel s differential equation. Orthogonality of Bessel functions.

MATH 386 Fluid Dynamics **(3-0)3/ECTS:6**

The ideal fluid. Irrotational flow. The vorticity equation. Steady flow past a wing. The equations of viscous flow. The diffusion of vorticity. Flow with circular streamlines. The convection and diffusion of vorticity. Waves. Surface waves. Dispersion, group velocity. Surface tension effects. Effects of finite depth. Sound waves. Classical Aerofoil Theory. Velocity potential and stream function. Method of images. Milne-Thompson's Circle theorem. Complex potential. Conformal mapping. Blasius' theorem. The Kutta- Juokowsli lift theorem. D'Alembert's paradox. Vortex motion. Kelvin's circulation theorem. The Helmholtz vortex theorems. Navier Stokes Equations. Very viscous flow.

MATH 387 An Introductıon Topology of Surfaces **(3-0)3/ECTS:6**

Point-set topology, triangulation, surfaces, classification of surfaces.

MATH 389 Introduction to Commutative Ring Theory **(3-0)3/ECTS: 6**

Definition of Rings, Ideals, and Examples. Prime and Maximal ideals. Ring Homomorphisms. Factor rings and Isomorphism Theorems. Zero-divisors, invertible elements, and nilpotent elements. The prime radical of a ring. Jacobson radical of a ring. Rings with descending chain conditions. Rings with ascending chain conditions. Examples of rings with chain conditions.

MATH 401 Quantum Mechanics **(3-0)3/ECTS:6**

Fundamental concepts. Kets, Bras, and operators. Measurements, observables. Uncertainty relations. Position and momentum space. Quantum dynamics. Time evolution and Schrödinger equation. The Schrödinger and Heisenberg picture. Simple harmonic oscillator. Schrödinger's wave equation. Propagators and Feynman path integral. Potentials and gauge transformations. Rotations and angular momentum. Spin. Rotation group. The density operator. Identical particles. Quantum statistics. Symmetries in quantum mechanics. Scattering theory.

MATH 403 Combinatorial Design Theory **(3-0)3/ECTS:6**

An overview of combinatorial design theory, main constructions and theorems. Relations with finite affine and projective spaces, as well as error-correcting codes.

MATH 404 Quantum Computations and Information **(3-0)3/ECTS:6**

Introduction to classical computation. Information and entropy. Introduction to quantum mechanics. Postulates of quantum mechanics. EPR paradox. Bell's inequalities. Quantum computation. The qubit. The Bloch sphere. The circuit model of quantum computation. Qubit gates. Controlled gates and entanglement generation. Universal quantum gates. Unitary errors. Function evaluation. The density operator. Von Neuman entropy. Entanglement measure. The quantum Fourier transform. Shor's algorithm. Quantum communication.

MATH 405 Variational Analysis **(3-0)3/ECTS:6**

The Euler-Lagrange equation. First integrals. Geodesics. The minimal surface of revolution. Several dependent variables. Isoperimetric problems. Fermat's principle. Dynamics of particles. The vibrating string. The Sturm-Liouville problem. The vibrating membrane. Theory of elasticity. Quantum mechanics. The principles of Feynman and Schwinger in Quantum mechanics. Variational principles in hydrodynamics.

MATH 406 Mathematics of Public Key Cryptography (3-0)3/ECTS:6

Introduction of mathematical foundations of public-key cryptography.

MATH 407 Conformal Mappings (3-0)3/ECTS:6

Analytic functions. Geometrical interpretation. Conformal transformations. Mobius transformations. Christofel-Schwarz conformal transformations. Conformal metric and geometry. Boundary value problems. Electrostatics, hydrodynamics.

MATH 408 Advanced Topics in Graph Theory (3-0)3/ECTS:6

Connectivity and Menger's theorem; embeddings of graphs and Kuratowski's theorem; network flows; crossing number; structure of k-chromatic graphs; Ramsey theory; extremal graph theory; probabilistic methods and random graphs; eigenvalues and eigenvectors of graphs.

MATH 409 Advanced Topics in Combinatorics (3-0)3/ECTS:6

Bijections, decompositions; composition and differentiation lemmas; algebra of formal power series; strings on finite alphabets; integer partitions; Ferrehs graph and Durfee square; Lagrange implicit function theorem; topics in lattices and posets.

MATH 410 Green's Functions (3-0)3/ECTS:6

Dirac's delta function. Generalized functions and properties. ODE and PDE with delta potential. Green's functions for ODE. Green's functions for wave, Heat, and Laplace equations. Klein-Gordon and Helmholtz equations. Boundary value problems.

MATH 411 Mathematical Optimization (3-0)3/ECTS:6

Concepts in optimization; modeling restrictions with linear constraints; convex sets, polyhedra and extreme points; simplex method; duality; sensitivity; topics in flows, integer programs and nonlinear optimization.

MATH 412 Hyperbolic Geometry (3-0)3/ECTS:6

Hyperbolic plane. The Mobius group. Conformality. Length and distance. Isometries. Planar models hyperbolic plane. Lobachevsly model. Poincare disk model. Klein model. Applications.

MATH 413 Linear and Nonlinear Waves (3-0)3/ECTS:6

Linear Harmonic Oscillator- Simple, Damped, and Forced Oscillations, Nonlinear Oscillations, Fourier transform and Convolution, Linear Wave Equations, Plane Waves and Dispersion Relation. Linear Dispersive Waves, Wave packets, Nonlinear Waves, Inviscid Burgers equation and Formation of Shocks, Nonlinear Diffusive waves and Viscous Burgers Equation, Shock and Multi-shock traveling Waves, Self-Similarity Solutions, Nonlinear Dispersive Waves, Korteweg-de Vries equation (KdV) and Solitary waves, Nonlinear Schrödinger equation and Solitons.

MATH 414 Introduction to Integral Equations (3-0)3/ECTS:6

Classification of integral equations. Solution of an integral equation. Relation between differential and integral equations. Fredholm integral equations. Volterra integral equations. Methods for solving integral equations.

Integro-differential equations: basic concepts and solution methods. Integral equations with singular kernels, Abel's problem. Nonlinear Fredholm and Volterra integral equations.

MATH 415 Mathematical Research Project I **(2-0)NC/ECTS:6**

At the beginning of the semester, the student chooses a research topic with the help of his supervisor. Then, the student is expected to do independent research on literature, learn new topics or results in mathematics, and work on analysis, problem-solving, or applications. The supervisor periodically reads and provides feedback on the development of the project. In the end, the student prepares a "Poster"and makes an oral presentation.

MATH 416 Mathematical Research Project II **(2-0)NC/ECTS:15**

The student can continue to work on his subject chosen in Math 415 or can choose a new research topic. As in Math 415, the student conducts independent study and periodically shares the progress with his supervisor. In the end, the student is expected to give a "Seminar" on the project work.

MATH 422 Introduction to Abelian Groups **(3-0)3/ECTS:6**

Abelian groups. Quotient groups. Isomorphism theorems. Torsion part of the group. Decomposition of torsion groups into a direct sum of primary groups. Divisibility. Injective groups. Structure of divisible groups. Projective groups. Free groups. Existence of epimorphisms from projective groups and of monomorphisms into injective groups. Pure subgroups. Basic subgroups. Bounded pure subgroups. Classification of torsion-free groups of rank one.

MATH 430 Contemporary Applications of Mathematics **(2-2)3/ECTS: 6**

Data Matrix and Numerical Attributes, Python Basics for Machine Learning and Data Analysis, Introduction to Kernel Methods, Kernel Principal Component Analysis, Clustering Techniques; K-Means Clustering, Clustering Techniques; Hierarchical Clustering, Decision Tree Classifier, Random Forest Classifier, Linear Discriminant Analysis, Multivariate Linear Regression, Multivariate Logistic Regression, Text Analysis, Kernel Support Vector Machines.

MATH 432 Analysis of Symmetric Encryption and Hash Functions **(3-0)3/ECTS: 6**

Design principles and security analysis of modern block ciphers, stream ciphers, hash functions and MACs. Feistel and SPN block ciphers, DES, AES, the design philosophy of AES, differential cryptanalysis, linear cryptanalysis, integral attack, algebraic attack, nonlinearity, branch number, difference tables, lightweight block ciphers, key schedules, round functions are covered in block cipher sides. Moreover, keystream generators, correlation attacks, LFSR-based stream ciphers, RC4, A5/1, and analyses are introduced. Hash functions and MAC algorithms, their security criteria, compression functions, Merkle-Damgard construction, SHA family, CMAC, and OMAC algorithms.

MATH 440 Knot Theory and its Applications **(3-0)3/ECTS: 6**

Review of surfaces, and manifolds. Smooth knot. Basic knot invariants. Coloring knots. Determinant of a knot. Orientation of knots, linking numbers, writhing. Kauffman bracket polynomial. Chirality in knots and chemical molecules, reversion, mutation, Tait Conjectures. Tangles. Braids, Alexander and Markov Theorems. Seifert surface and genus of a knot. Types of knots.

MATH 438 Mathematical Foundation of Deep Learning **(3-0)3/ECTS: 6**

Mathematical methods for Deep Learning, Regression Types, Perceptron Models, Shallow Networks, Universal Approximation Theorem, Feedforward NN, SGD Convergence Analysis, Backpropagation, Regularization, L^2 and L^1 Penalties, Mathematical Intuition of RNNs, Application of CNNs.

MATH 441 Introduction to Geometric Topology (3-0)3/ECTS: 6

Manifolds, point-set topology, topological spaces

MATH 443 Introduction to Analytic Number Theory (3-0)3/ECTS: 6

Arithmetical functions, Dirichlet multiplication, averages of arithmetical functions, distribution of prime numbers, Dirichlet's theorem

MATH 444 Introduction to Modules And Rings (3-0)3/ECTS:6

Definition of Modules. Submodules and examples. Module Homomorphisms. Direct product and Direct sum of modules. Free and projective modules. Maximal and small submodules. Radical of modules. Essential and Simple submodules. Socle of modules. Injective Modules. Injective Hull of Modules.

MATH 445 Mathematical Aspects Of Blockchain Technologies (3-0)3/ECTS:6

The general scope of the course consists of design principles and security analysis of cryptographic building blocks and protocols of blockchain technologies and schemes.

MATH 446 Supplementary Curricular Courses (3-0)3/ECTS:6

Students attend online courses, certificate programs, physically received certificate programs, and national or international summer schools, offered on digital platforms in a number determined by the departments during each semester or throughout their undergraduate education and can apply for a credited Education Plan Supporting Field Course by documenting that they have registered and successfully completed the courses they have taken within the specified time intervals. During the whole undergraduate education, a maximum of 1 course can be taken with credit in this status.

MATH 447 Entrepreneurship Education (3-0)3/ECTS:6

Entrepreneurship and its history. Role of Entrepreneurship in Economics. Entrepreneurship types. Creative thinking. The decision process. Role models and success stories in Mathematics and computer sciences. Importance of communication, risk-taking, and resilience. Various forms of business organization, mission, vision, and strategy formulation. Sources of business ideas, finding and assessing ideas, opportunity recognition. Idea evaluation and solution generation. Development of ideas. Project presentations. Feasibility analysis. Industry and competition analysis. Environment analysis. Financial feasibility analysis. Start-up projects**.** Obtaining business licenses and permits. Ethics

MATH 450 Scale Invariance and Dimensional Analysis (3-0)3/ECTS:6

Dimensional analysis, similarity and modeling. Self-similar solutions. Group of transformations. Stability. Fractals and self-similarity. Applications to hydrodynamics. Renormalization group.

MATH 451 Mathematics and Technology (3-0)3/ECTS:6

Positioning on Earth and in Space: GPS. Friezes and mosaics: symmetry groups and transformations. Robotic motion. Saving and loans. Image compression: fractals and attractors. Science flashes.

MATH 452 Functional Analysis (3-0)3/ECTS:6

Metric spaces. Banach and Hilbert Spaces. Linear Operators on Normed Spaces, Bounded and Compact Operators. Spaces of Linear Operators and Convergence. Fundamental Theorems for Normed and Banach Spaces: Hanh-Banach Theorem, Uniform Boundedness Theorem, Open Mapping Theorem, Closed Graph Theorem. Linear Functionals on Hilbert Spaces and Riesz Representation Theorem. Adjoint, Self-adjoint, Unitary and Normal Operators. Spectrum and Resolvent of an Operator. Spectral Properties of Bounded and Compact

Operators. Unbounded Operators.

MATH 453 Introduction to Generalized Functions (3-0)3/ECTS:6

Heaviside function and Delta-sequences. Test functions. Linear functionals and definition of a distribution (generalized function). Regular and singular distributions. Algebraic operations on distributions: linear change of variables, the product of a distribution by a function. Analytic operations on distributions: derivative of a distribution. Transformation properties of Dirac-delta distribution. Schwartz space and tempered distributions: definitions and basic properties. Fourier transform of distributions. Convolution. The concept of the generalized solution of a differential equation. Applications to Differential equations: Fundamental solutions and Green's functions.

MATH 455 Control of Infinite Dimensional Systems (3-0)3/ECTS:6

Controllability and observability of PDEs (using back-stepping methods).

MATH 456 Galois Theory (3-0)3/ECTS:6

Cubic and quartic equations. Cardan's Formulas. Symmetric polynomials. Discriminant. Roots of polynomials. The Fundamental Theorem of Algebra. Extension fields. Minimal polynomials. Adjoining elements. Degree of a field extension. Finite extensions. The tower theorem. Algebraic extensions. Simple extensions. Splitting fields, their uniqueness up to isomorphism. Normal extensions. Separable extensions. Fields of characteristic 0 and fields of characteristic p. The Primitive Element Theorem. Galois group. Galois group of splitting fields. Permutation of the roots. Examples of Galois groups. Abelian equations. Galois extensions. The Fundamental Theorem of Galois Theory. Solvability by radicals. Solvable groups. Cyclotomic extensions. Regular polygons and roots of unity. Impossibility of some geometric constructions using just a straightedge and compass. Finite fields.

MATH 457 Methods of Mathematical Economics (3-0)3 ECTS:6

Introduction to linear programming. Examples from economics, the transportation problem, the diet problem, Chebyshev approximation. Representations of linear programs. Graphical solution. The Simplex method. Brief review of some linear algebra. The simplex tableau. Convergence of the simplex method. Linear programming in matrix form. Duality. Duality for linear programs in canonical form. The dual of a linear program in general form. Complementary slackness. The separating hyper plane theorem. Perturbations and parametric programming. Zero-sum matrix games. Multi objective linear programming. Integer linear programming: Gomory's method. Network flows. Assignment and shortest-route problems.

MATH 481 Differential Equations with Numerical Methods (2-2)3/ECTS:6

Initial and Boundary Value Problems. Heat Equation. Wave Equation. Elliptic PDE problems. Reaction- Convection-Diffusion Problems. Upwind and Centred Approximation Method. Poisson equation in 2D. Explicit and Implicit methods.

MATH 482 Numerical Solution of Linear Integral Equations (3-0)3/ECTS:6

Compact operator. The Fredholm alternative. Degenerate kernel methods. Projection methods. The Nyström method. Global approximation methods on smooth surfaces. Solution of integral equations on the unit sphere.

MATH 494 Mathematical Methods for Data Analysis (3-0)3/ECTS:6

Linear regression, Logistic regression, Overfitting, Regularization, and model validation techniques, Support Vector Machines (SVM), Clustering, Principal Component Analysis (PCA), Feedforward Neural Networks, Convolutional Neural Networks (CNN), Recurrent Neural Networks (RNN).

MATH 499 Cooperative Education Course **(0-12)6/ECTS:6**

Within the scope of this course, students will receive introductory courses during the first two weeks of the semester covering the topics of learning outcomes and objectives of cooperative education and evaluation of the work experience. Following this, students are installed to the jobs where they are obliged to work two days a week. Students daily summarize what is done in a journal and provide a report by the end of the semester which they also have to present and defend in front of the jury.