Accreditation Request
Fact Sheet

1. **Applicant University**

   Eötvös Loránd University
   1053 Budapest, Egyetem tér 1-3.
   Postal address: 1364 Budapest, Pf.: 10.

2. **Host Faculty**

   Faculty of Informatics
   1117 Budapest, Pázmány Péter sétány 1/C

3. **Description of the programme**

   BSc in Program Designer

4. **Qualification (as it appears in the Diploma)**

   BSc in Program Designer

5. **Level of education**

   Bachelor

6. **Requirements for the degree**

   Duration: 6 semesters
   Total number of hours: 5600
   From which contact hours: 2400
   Number of credits: 180

7. **Starting date of the BSc programme**

   Fall semester of the academic year 2010/2011

8. **Faculty member responsible for the programme**

.....
Dr. Kozma László
Dean of the Faculty of Informatics

Budapest, November 12, 2009

.....
Dr. Hudecz Ferenc
Rector

Name of the course: Precalculus practices

Course code: IP-08MATAG

Faculty member responsible for the course: Pál Jenő

Total credits: 1

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		1	
Hours per week		2	
Type of testing		three graded	

Topics:

Logical bases (the use of expressions with logical signs $\forall$ and $\exists$). Algebraic and radical expressions (identities, polynomials). Proofs by mathematical induction. Quadratic equations and inequalities. Solving equations and inequalities. Functions (domain, graph, transformations, inverse). Trigonometric identities, equations, inequalities and functions. Sequences (arithmetic and geometric sequence, boundedness, monotonicity). Summation, set of points.

Literature:

David Cohen: Precalculus: A Problems-Oriented Approach (Cengage Learning Services 2005, 6 Rev. Ed.)
Fred Safier: Schaum's Outline of Precalculus (McGraw-Hill 2008, 2 Rev. Ed.)
Matematikai alapozás (oktatási segédanyag, 2008)

Recommended literature:

Bagota-Kovács-Krisztin-Német: Matematikai Praktikum feladatgyűjtemény (Polygon)
Kosztolányi-Kovács-Pintér-Urbán-Vincze: Sokszínű matematika 12 (Nemzeti Tankönyvkiadó)
Hajnal-Számadó-Békéssy: Matematika 12 (Nemzeti Tankönyvkiadó)

Name of the course: Analysis 1

Course code: IP-08eAN1E, IP-08eAN1G

Faculty member responsible for the course: Simon Péter

Total credits: 6

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	1	3
Type of testing	exam	practice	

Topics:

The set of real numbers, bounded sets, least upper bound (sup), greatest lower bound (inf). Numerical sequences, monotone sequences. Convergence, Cauchy criterion. Algebraic operations and convergence. Convergence of monotone sequences. The n-th root of numbers. Extended real number line, limit in extended sense. Infinite numerical series, convergence, absolute convergence. Convergence tests. Alternating (Leibniz type) series. The associativity (brackets in the series). The permutation of the terms. Products of series, Mertens' theorem. p-adic fraction representation of real numbers. Power series, Cauchy-Hadamard theorem. Sum function of power series, elementary functions. Limits of functions. „Transfer principle", limits and algebraic operations. Limits of analytic and monotone functions. Continuity, discontinuity. Connections between limit and continuity. „Transfer principle" for continuous functions, algebraic operations with continuous functions. Continuity of composition of functions. Bolzano's theorem, Darboux property. Continuity of analytic functions. Extremal values of continuous functions on compact intervals. Weierstrass' theorem. Uniform continuity, Heine's theorem. Continuity of inverse functions.

Literature:

T. Tao: Analysis I (Hindustan Book Agency (India), 2006)
G. B. Thomas - M. D. Weir - J. Hass - F. R. Giordano: Thomas's Calculus, 11th Ed. (Pearson Education, Inc, 2005)
Leindler László, Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: *Analízis II.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: *Analízis feladatokban I.* (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:

Balázs M., Kolumbán J.: *Matematikai analízis* (Dacia Könyvkiadó, Kolozsvár-Napoca, 1978)
Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, JATE, Pécs, 1994)
Simon Péter: *Fejezetek az analízisből* (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
W. Rudin: *A matematikai analízis alapjai* (Műszaki Könyvkiadó, Budapest, 1978)

Name of the course: Analysis 1

Course code: IP-08aAN1E, IP-08aAN1G, IP-08bAN1E, IP-08bAN1G, IP-08cAN1E, IP-08cAN1G, IP-08tAN1E, IP-08tAN1G

Faculty member responsible for the course: Simon Péter

Total credits: 5

Total hours: 4

Type of the course	**Lecture**	**Practice**	**Consultation**
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

The set of real numbers, bounded sets, least upper bound (sup), greatest lower bound (inf). Numerical sequences, monotone sequences. Convergence, Cauchy criterion. Algebraic operations and convergence. Convergence of monotone sequences. The n-th root of numbers. Extended real number line, limit in extended sense. Infinite numerical series, convergence, absolute convergence. Convergence tests. Alternating (Leibniz type) series. The associativity (brackets in the series). The permutation of the terms. Products of series, Mertens' theorem. p-adic fraction representation of real numbers. Power series, Cauchy-Hadamard theorem. Sum function of power series, elementary functions. Limits of functions. „Transfer principle", limits and algebraic operations. Limits of analytic and monotone functions. Continuity, discontinuity. Connections between limit and continuity. „Transfer principle" for continuous functions, algebraic operations with continuous functions. Continuity of composition of functions. Bolzano's theorem, Darboux property. Continuity of analytic functions. Extremal values of continuous functions on compact intervals. Weierstrass' theorem. Uniform continuity, Heine's theorem. Continuity of inverse functions.

Literature:

T. Tao: Analysis I (Hindustan Book Agency (India), 2006)
G. B. Thomas - M. D. Weir - J. Hass - F. R. Giordano: Thomas's Calculus, 11th Ed. (Pearson Education, Inc, 2005)
Leindler László, Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: *Analízis II.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: *Analízis feladatokban I.* (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:

Balázs M., Kolumbán J.: *Matematikai analízis* (Dacia Könyvkiadó, Kolozsvár-Napoca, 1978)
Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, JATE, Pécs, 1994)
Simon Péter: *Fejezetek az analízisből* (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
W. Rudin: *A matematikai analízis alapjai* (Műszaki Könyvkiadó, Budapest, 1978)

Name of the course: Analysis 2

Course code: IP-08aAN2E, IP-08aAN2G, IP-08bAN2E, IP-08bAN2G, IP-08cAN2E, IP-08cAN2G

Faculty member responsible for the course: Simon Péter

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:
Differentiability of real functions.
Taylor series.
Applications of differentiability.
Mean value theorems.
The L'Hospital rule.
Convex and concave functions. Investigation of functions.
Primitive functions. The Riemann integral, Newton-Leibniz rule.
The definite integral function.
Applications of Riemann integral: area, length, cube, surface.

Literature:
T. Tao: Analysis I (Hindustan Book Agency (India), 2006)
Leindler László, Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: *Analízis II.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: *Analízis feladatokban I.* (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:
Balázs M., Kolumbán J.: *Matematikai analízis* (Dacia Könyvkiadó, Kolozsvár-Napoca, 1978)
Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, JATE, Pécs, 1994)
Simon Péter: *Fejezetek az analízisből* (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
W. Rudin: *A matematikai analízis alapjai* (Műszaki Könyvkiadó, Budapest, 1978)

Name of the course: Analysis 2

Course code: IP-08eAN2E, IP-08eAN2G

Faculty member responsible for the course: Simon Péter

Total credits: 2

Total hours: 1

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week		1	1
Type of testing		practice	

Topics:
Differentiability of real functions.
Taylor series.
Applications of differentiability.
Mean value theorems.
The L'Hospital rule.
Convex and concave functions. Investigation of functions.
Primitive functions. The Riemann integral, Newton-Leibniz rule.
The definite integral function. Applications of Riemann integral: area, length, cube, surface.

Literature:
T. Tao: Analysis I (Hindustan Book Agency (India), 2006)
Leindler László, Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: *Analízis II.* (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: *Analízis feladatokban I.* (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:
Balázs M., Kolumbán J.: *Matematikai analízis* (Dacia Könyvkiadó, Kolozsvár-Napoca, 1978)
Schipp Ferenc: *Analízis I.* (egyetemi jegyzet, JATE, Pécs, 1994)
Simon Péter: *Fejezetek az analízisből* (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
W. Rudin: *A matematikai analízis alapjai* (Műszaki Könyvkiadó, Budapest, 1978)

Name of the course: Analysis 3

Course code: IP-08aAN3E, IP-08aAN3G

Faculty member responsible for the course: Simon Péter

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:
Basic topological properties of finite dimensional linear spaces.
Vector sequences and their convergence.
Compact sets of vectors.
Limit and the continuity of vector-vector functions.
Curves and surfaces.
Differentiability of vector-vector functions.
Jacobian matrices, gradient.
The basic rules of differentiation.
Young's and Taylor's theorems.
Applications of differentiation, extrema.
The Riemann integral of multivariable functions.
Transformations of the integral.
Applications in geometry and physics.

Literature:
T. Tao: Analysis I (Hindustan Book Agency (India), 2006)
Leindler László, Schipp Ferenc: Analízis I. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: Analízis II. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: Analízis feladatokban I. (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:
Balázs M., Kolumbán J.: Matematikai analízis (Dacia Könyvkiadó, Kolozsvár-Napoca, 1978)
Schipp Ferenc: Analízis I. (egyetemi jegyzet, JATE, Pécs, 1994)
Simon Péter: Fejezetek az analízisből (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
W. Rudin: A matematikai analízis alapjai (Műszaki Könyvkiadó, Budapest, 1978)

Name of the course: Analysis 3

Course code: IP-08bAN3G, IP-08cAN3G, IP-08eAN3EG

Faculty member responsible for the course: Simon Péter

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	1	2	1
Type of testing		practice	

Topics:

The basic topological notions of the space R^n (n ε N): metric, norm, neighbourhood, interior point, open and closed sets, accumulation point.
Convergent vector series, Cauchy criterion.
Limit and continuity of multivariable vector valued functions, the role of coordinate functions.
The properties of continuous functions defined on bounded and closed sets: Weierstrass and Heine theorems, the continuity of inverse functions.
The fixed point theorem. The parametrization of curves and surfaces.
Differentiability of multivariable vector valued functions, the role of coordinate functions. The Jacobian matrix, gradient, partial derivative.
Multiple times differentiable functions, Young's theorem (without proof). Taylor's theorem in Lagrange form of the remainder, Quadratic forms, basic properties.
Extrema of multivariable functions.
Multiple integrals, successive integration. The change of variables theorem (without proof), polar and cylindrical coordinates.
Geometrical and physical applications.

Literature:

W. Rudin: Principles of Mathematical Analysis
W. R. Wade: An Introduction to Analysis (Prentice Hall, 1995)
Leindler László, Schipp Ferenc: Analízis I. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: Analízis II. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: Analízis feladatokban I. (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:

Balázs M., Kolumbán J.: Matematikai analízis (Dacia Könyvkiadó, Kolozsvár-Napoca, 1978)
Schipp Ferenc: Analízis I. (egyetemi jegyzet, JATE, Pécs, 1994)
Simon Péter: Fejezetek az analízisből (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
W. Rudin: A matematikai analízis alapjai (Műszaki Könyvkiadó, Budapest, 1978)

Name of the course: Applications of Analysis 1

Course code: IP-08aANA1E, IP-08aANA1G

Faculty member responsible for the course: Weisz Ferenc

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

The implicit and inverse function theorems.
Constrained extrema of multivariable real valued functions.
Ordinary differential equation, initial value problems.
Special first order differential equations: separable, exact and linear equations.
Solution of initial value problems, the Picard-Lindelöf theorem. Successive approximation. Unicity, maximal solution.
Linear systems of differential equations, the structure of the set of solutions, fundemental matrix, the variation of constants. The case of constant coefficients with diagonalizable matrix.
Higher order linear differential equations, transformation into linear systems. Structure of the set of solutions. The case of constant coefficients, special right hand side.
Sequences and series of functions. Convergence and uniform convergence, the Weierstrass majorant test. Continuity, integrability and differentiability of the limit function.
Elements of Fourier analysis: orthogonality of the trigonometric system, completeness in $C_{2\pi}$.
Uniformly convergent trigonometric series: Fourier series, Fourier coefficients, partial sums of the Fourier series. The minimal property of partial sums. Bessel identity, Bessel inequality, Parseval identity.
Explicit form and role of Dirichlet kernels.
Fourier series of differentiable functions. The convergence and sum of the $\sum_k=1^\infty k^-1\sin\,kx$ $\;(x\in R)$
The problem of vibrating strings. The notion of smooth path. The line integral. The Newton-Leibniz formula for the line integrals.
The connection between integrals on closed paths and primitive functions.
Primitive functions of the function defined on star domains. Force field, work, potential.

Literature:

W. Rudin: Principles of Mathematical Analysis
W. R. Wade: An Introduction to Analysis (Prentice Hall, 1995)
Leindler László, Schipp Ferenc: Analízis I. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: Analízis II. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: Analízis feladatokban I. (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:

Balázs M., Kolumbán J.: Matematikai analízis (Dacia Könyvkiadó, Kolozsvár-Napoca, 1978)
Schipp Ferenc: Analízis I. (egyetemi jegyzet, JATE, Pécs, 1994)
Simon Péter: Fejezetek az analízisből (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
W. Rudin: A matematikai analízis alapjai (Műszaki Könyvkiadó, Budapest, 1978)

Name of the course: Mathematics I 1

Course code: IP-08tMATI1E, IP-08tMATI1G

Faculty member responsible for the course: Kovács Sándor

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

Properties of real functions (zero, sign, boundedness, monotonicity, extremum, convexity resp. concavity, parity).
Polynomials and rational function (division by rest, roots, factorization, partial fractions).
Elementary functions (exp, sin, cos, tan, cot, sinh, cosh, tanh, coth)
Properties of elementary functions, graphs.
The definition of the derivative, basic properties.
Rules for finding derivatives.
Mean value theorems and their geometric interpretations.
Derivative of elementary functions.
Taylor's formula.
Application of derivatives: rate of change, increasing/decreasing functions, tangents and normals, approximation, maxima and minima.
The Riemann integral. Riemann sums. The Fundamental Theorem of Calculus. Improper Riemann integration.
Application of integrals.
Vectors and scalars, magnitude and direction of a vector. Scalar, dot products.
Coordinates of a point in space, distance between two points; section formula. Cartesian and vector equation of a line, coplanar and skew lines, distance between two lines. Cartesian and vector equation of the plane. Angle between two lines, two planes, a line and a plane. Distance of a point from a plane. Scalar and vector triple product. Application of vectors to plane geometry.

Literature:

W. R. Wade: An Introduction to Analysis (Prentice Hall, 1995)
Leslie Hogben: Handbook of Linear Algebra (Chapman and Hall, 2007)

Recommended literature:

Name of the course: Mathematics I 2

Course code: IP-08tMATI2E, IP-08tMATI2G

Faculty member responsible for the course: Kovács Sándor

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

Determinant and matrices. Evaluation of determinants. Area of triangles using determinants. Adjoint and inverse matrix. Test of consistency and solution of simultaneous linear equations using determinants and matrices.

Vector spaces. Linear combination of vectors. Linear dependence, basis, dimension. Special matrices.

Eigenvalues and eigenvectors of matrices. The linear mapping, image and kernel, theorem on the dimension.

Quadratic forms, definiteness, the theorem of Sylvester.

Spaces: metric, normed and Euclidean spaces. Orthogonality, the theorem of Gram-Schmidt.

Partial derivatives. The definition of differentiability. Differentiability theorems. The Mean Value Theorem and Taylor's formula.

Differential Equations: definition, order and degree, general and particular solutions of a differential equation. Solution of differential equations by method of separation of variables, homogeneous differential equations. Solutions of linear differential equations.

Literature:

W. R. Wade: An Introduction to Analysis (Prentice Hall, 1995)
Leslie Hogben: Handbook of Linear Algebra (Chapman and Hall, 2007)
R. Bronson: Differential Equations (McGRaw Hill, 2003)

Recommended literature:

Name of the course: Numerical methods 1

Course code: IP-08aNM1E, IP-08aNM1G, IP-08bNM1E, IP-08bNM1G, IP-08cNM1E, IP-08cNM1G

Faculty member responsible for the course: Krebsz Anna

Total credits: 5

Total hours: 4

Type of the course	**Lecture**	**Practice**	**Consultation**
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

Floating point representation of numbers, absolute error, relative error.

Norms and condition numbers.
Solving systems of linear equations: Gaussian elimination, pivoting, LU, LDU, ILU QR, Cholesky decomposition. Iterative methods: Jacobi, Gauss-Seidel, Richardson, ILU iteration.

Iterative solution of nonlinear equations: secant and bisection method, fixed point iteration, Newton's method.

Literature:

Hammerlin-Hoffmann, Numerical Mathematics (Springer, 1991)
Süli-Mayers, An Introduction to Numerical Analysis (Cambridge, 2003)

Recommended literature:

Stoer-Bulirsch, Introduction to Numerical Analysis (Springer, 1980)

Name of the course: Numerical methods 1

Course code: IP-08eNM1E, IP-08eNM1G

Faculty member responsible for the course: Krebsz Anna

Total credits: 5

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	1	2
Type of testing	exam	practice	

Topics:

Floating point representation of numbers, absolute error, relative error.

Norms and condition numbers.
Solving systems of linear equations: Gaussian elimination, pivoting, LU, QR, Cholesky decomposition. Iterative methods: Jacobi, Gauss-Seidel, Richardson,
ILU iteration.

Iterative solution of nonlinear equations: secant and bisection method, fixed point iteration, Newton's method.

Literature:

Hammerlin-Hoffmann, Numerical Mathematics (Springer, 1991)
Süli-Mayers, An Introduction to Numerical Analysis (Cambridge, 2003)

Recommended literature:

Stoer-Bulirsch, Introduction to Numerical Analysis (Springer, 1980)

Name of the course: Numerical methods 2

Course code: IP-08aNM2E, IP-08aNM2G

Faculty member responsible for the course: Krebsz Anna

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

Eigenvalues, eigenvectors: Gersgorin theorems. The power method, inverse iteration, Jacobi's method, eigenvalues of tridiagonal matrices. LR, QR algorithm.

Polynomial interpolation: Lagrange form, divided difference form, error of the interpolation, Hermite interpolation, Spline interpolation. Singular value decomposition, the Moore-Penrose generalised inverse. Least squares approximation to discrete data.

Numerical integration: Newton Cotes formulas, composite forms. Orthogonal polynomials, Chebysev, Gauss quadrature.

Literature:

Hammerlin-Hoffmann, Numerical Mathematics (Springer, 1991)
Süli-Mayers, An Introduction to Numerical Analysis (Cambridge, 2003)

Recommended literature:

Stoer-Bulirsch, Introduction to Numerical Analysis (Springer, 1980)

Name of the course: Numerical methods 2

Course code: IP-08bNM2EG

Faculty member responsible for the course: Krebsz Anna

Total credits: 3

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	1	2	
Hours per week	1	2	
Type of testing	exam	practice	

Topics:

Polynomial interpolation: Lagrange form, divided difference form, error of the interpolation, Hermite interpolation, Spline interpolation.

Singular value decomposition, the Moore-Penrose generalised inverse. Least squares approximation to discrete data.

Numerical integration: Newton Cotes formulas, composite forms. Orthogonal polynomials, Chebysev, Gauss quadrature.

Literature:

Hammerlin-Hoffmann, Numerical Mathematics (Springer, 1991)
Süli-Mayers, An Introduction to Numerical Analysis (Cambridge, 2003)

Recommended literature:

Stoer-Bulirsch, Introduction to Numerical Analysis (Springer, 1980)

Name of the course: Numerical methods

Course code: IP-08tNMG

Faculty member responsible for the course: Krebsz Anna

Total credits: 3

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit		3	
Hours per week		3	
Type of testing		practice	

Topics:

Solving systems of linear equations: Gaussian elimination, pivoting, LU decomposition. Iterative methods: Jacobi, Gauss-Seidel iteration.

Iterative solution of nonlinear equations: secant and bisection method, fixed point iteration, Newton's method.

Polynomial interpolation: Lagrange form, divided difference form, error of the interpolation, Hermite interpolation.

Least squares approximation to discrete data.

Numerical integration: Newton Cotes formulas, composite forms.

Literature:

Hammerlin-Hoffmann, Numerical Mathematics (Springer, 1991)
Süli-Mayers, An Introduction to Numerical Analysis (Cambridge, 2003)

Recommended literature:

Stoer-Bulirsch, Introduction to Numerical Analysis (Springer, 1980)

Name of the course: Computer Algebra Systems

Course code: IP-08aKARE, IP-08aKARG

Faculty member responsible for the course: Kovács Attila

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

Introduction to computer algebra systems, Maple, Mathematica.
Language elements, control structures, data types, data structures, tables and arrays, procedures, functions, operators, object representations, graphics (2D, 3D), other possibilities. Packages, extensions.
General and specific examples: high precision arithmetic, number theory, linear algebra, polynomials, limits, sums, integration, differentiation, solving systems of equations, numerical computations.
Case studies: RSA, ElGamal, Miller-Rabin test, etc.

Literature:

von zur Gathen, Gerhard: Modern Computer Algebra
A. Heck: Bevezetés a Maple használatába (JGYF Kiadó Szeged, 1999)

Recommended literature:

A. Heck: Introduction to Maple, Springer, 2003

Name of the course: Logic and theory of computation

Course code: IP-08aLSZE, IP-08aLSZG, IP-08bLSZE, IP-08bLSZG, IP-08cLSZE, IP-08cLSZG, IP-08tLSZE, IP-08tLSZG

Faculty member responsible for the course: Pásztor Endréné

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

The subject and the aim of logic. The most important mathematical tools. The notion of the language. Propositional logic: Description language and semantical properties of the formulas. Semantical notion of the consequence. Deduction theorem. Decision problems. Semantical/tautological equivalence. Laws of propositional logic. Formalization. Ways of inference. Problem solving. First-order logic. First-order and zero-order statements. Description language, signature. One- and many-sorted logic. Formalization by first-order formulas. Syntactical test of first-order formulas. Term substitution. Mathematical structure and it's description language. Semantics, interpretation, and variable evaluation. Possible interpretation stuctures for a given universe U and a given signature. Truth table and value table of a formula. Basic expressions. Semantical notion of the consequence. Deduction theorem. Decision problems. Impossibility of the semantical solution. Logical equivalent rewriting of propositional formulas. Decision algorithm, deduction process. Conjunctive normal forms. Set of clauses and the semantical trees. Logical equivalent rewriting of first-order formulas. Prenex and Skolem formulas. The unsatisfiability of a first-order set of clauses. Herbrand universe. The resolution principle. Resolution strategies (Linear-, linear input-, unit resolution). Horn clauses. Horn logic. Complete deduction tree for the linear input strategy. Problem solving. The linear input strategy in connection with Prolog.

The computational and decision problems. The connection between a decidable problem and a formal language. Turing machine as algorithm model. The definition of the Turing machine and the recognized language. Multi tape and nondeterministic Turing machines. Time complexity. Decoding Turing machines in binary words. Undecidable problems concerning Turing machines: the diagonalization and the universal language, the halting problem. Turing machines computing functions on strings. Reductions. Further undecidable problems: PCP, ambiguity of CF grammars, validity of first-order formulas. The P and the NP complexity classes. Polinomial time reduction. NP-completeness. Cook's theorem: SAT is NP-complete. Further NP-complete problems: variants of SAT, problems concerning graphs, Hamilton circle problem). The polinomial space and PSPACE-complete problems.

Literature:

M. Ben Ari: Mathematical logic for Computer Science, Springer 2001
J. H. Gallier: Logic for Computer Science Wiley 1986
Lecture notes of the part „Theory of computation" is available in electronic form on the web
Pásztorné Varga Katalin, Várterész Magda: *A matematikai logika alkalmazásszemléletű tárgyalása*, 2003.

Recommended literature:

C. L. Chang & R. C. T. Lee: *Symbolic Logic and Mechanical Theorem Proving.* 1973
Ruzsa, I, Máté A. *Bevezetés a modern logikába.* 1997.
M. Huth, M. Ryan: Logic in Computer Science Cambridge University Press, 2000
Samuel D. Guttenplan, Martin Tamny: *Logic, a Comprehensive Introduction, Basic Books*, 1971.
Michael Sipser: *Introduction to the Theory of Computation*, 2006.
J.E. Hopcroft, R. Motwani, J.D. Ullman: *Introduction to Automata Theory, Languages, and Computation*, 2003.
C. H. Papadimitriou: *Számítási Bonyolultság*, 1999.
Demetrovics János, Jordan Denev, Anton Pavlov: *A számítástudomány matematikai alapjai, Tankönyvkiadó, Budapest*, 1985.

Name of the course: Logic and theory of computation

Course code: IP-08eLSZE, IP-08eLSZG

Faculty member responsible for the course: Pásztor Endréné

Total credits: 5

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	1	2
Type of testing	exam	practice	

Topics:

The subject and the aim of logic. The most important mathematical tools. The notion of the language. Propositional logic: Description language and semantical properties of the formulas. Semantical notion of the consequence. Deduction theorem. Decision problems. Semantical/tautological equivalence. Laws of propositional logic. Formalization. Ways of inference. Problem solving. First-order logic. First-order and zero-order statements. Description language, signature. One- and many-sorted logic. Formalization by first-order formulas. Syntactical test of first-order formulas. Term substitution. Mathematical structure and it's description language. Semantics, interpretation, and variable evaluation. Possible interpretation stuctures for a given universe U and a given signature. Truth table and value table of a formula. Basic expressions. Semantical notion of the consequence. Deduction theorem. Decision problems. Impossibility of the semantical solution. Logical equivalent rewriting of propositional formulas. Decision algorithm, deduction process. Conjunctive normal forms. Set of clauses and the semantical trees. Logical equivalent rewriting of first-order formulas. Prenex and Skolem formulas. The unsatisfiability of a first-order set of clauses. Herbrand universe. The resolution principle. Resolution strategies (Linear-, linear input-, unit resolution). Horn clauses. Horn logic. Complete deduction tree for the linear input strategy. Problem solving. The linear input strategy in connection with Prolog.

The computational and decision problems. The connection between a decidable problem and a formal language. Turing machine as algorithm model. The definition of the Turing machine and the recognized language. Multi tape and nondeterministic Turing machines. Time complexity. Decoding Turing machines in binary words. Undecidable problems concerning Turing machines: the diagonalization and the universal language, the halting problem. Turing machines computing functions on strings. Reductions. Further undecidable problems: PCP, ambiguity of CF grammars, validity of first-order formulas. The P and the NP complexity classes. Polinomial time reduction. NP-completeness. Cook's theorem: SAT is NP-complete. Further NP-complete problems: variants of SAT, problems concerning graphs, Hamilton circle problem). The polinomial space and PSPACE-complete problems.

Literature:

M. Ben Ari: Mathematical logic for Computer Science, Springer 2001
J. H. Gallier: Logic for Computer Science Wiley 1986
Lecture notes of the part „Theory of computation" is available in electronic form on the web
Pásztorné Varga Katalin, Várterész Magda: *A matematikai logika alkalmazásszemléletű tárgyalása*, 2003.

Recommended literature:

C. L. Chang & R. C. T. Lee: *Symbolic Logic and Mechanical Theorem Proving.* 1973

Ruzsa, I, Máté A. *Bevezetés a modern logikába.* 1997.

M. Huth, M. Ryan: Logic in Computer Science Cambridge University Press, 2000

Samuel D. Guttenplan, Martin Tamny: *Logic, a Comprehensive Introduction, Basic Books,* 1971.

Michael Sipser: *Introduction to the Theory of Computation*, 2006.

J.E. Hopcroft, R. Motwani, J.D. Ullman: *Introduction to Automata Theory, Languages, and Computation*, 2003.

C. H. Papadimitriou: *Számítási Bonyolultság*, 1999.

Demetrovics János, Jordan Denev, Anton Pavlov: *A számítástudomány matematikai alapjai, Tankönyvkiadó, Budapest*, 1985.

Name of the course: Distributed systems

Course code: IP-08cORE

Faculty member responsible for the course: Horváth Zoltán

Total credits: 5

Total hours: 5

Type of the course	Lecture	Practice	Consultation
Credit	2	3	
Hours per week	2	2	1
Type of testing	combined		

Topics:

The course presents the main concepts of distributed systems and middlewares. Students get programming assignments in Java.

Concepts: middleware, distributed file systems, persistency, transparencies: access, location, relocation, migration, replication, concurrency, failure, persistency. Scalability, transactions, authentication and authorization. Client-server model. Communication: protocols, message passing, channels, RPC, RMI, parameter passing, references, distributed object model. Processes:, threads, multithreaded clients and servers, code migration, agents, trusted code. Name spaces, mobile entities, reference counting, distributed garbage collection. Global state, consistent cut, time stamp, termination detection, clock synchronization). Consistent replications.

Literature:

Tanenbaum, A.S. - van Steen, M.: Distributed Systems, Principles and Paradigms. Prentice Hall, 2002.

Recommended literature:

Coulouris G., Dollimore, J., Kindberg, T.: Distributed Systems: Concepts and Design, Addison Wesley 2000.

Name of the course: Specification and implementation of distributed systems

Course code: IP-08bORSI

Faculty member responsible for the course: Horváth Zoltán

Total credits: 5

Total hours: 5

Type of the course	Lecture	Practice	Consultation
Credit	2	3	
Hours per week	2	2	1
Type of testing	combined		

Topics:

The course introduces the main concepts of programming of distributed and parallel systems and students gets programming assignments, get experience in design and implementation of distributed programs.

Concepts: Specification of distributed programs, task, abstract parallel program, fairness, interleaving semantics, atomicity. Invariants, safety and progress properties. Reachable states. Derivation rules for synthesis of correct programs: refinement of safety and progress properties, application of variant function. Programming theorems: associative operator (prefix sum), maximum search. Composition of programs: union, superposition, sequence, derivation rules. Locality theorem, communication primitives (synchronic and asynchronic), message passing, channel variables, pipeline, fork and multiplexer. Programming assignments in PVM.

Literature:

Chandy,K.M. - Misra,J.: Parallel Program Design: A Foundation. Addison-Wesley, 1989.

Recommended literature:

Coulouris G., Dollimore, J., Kindberg, T.: Distributed Systems: Concepts and Design, Addison-Wesley, 2000.

Name of the course: Formal Languages

Course code: IP-08aFNYEG, IP-08bFNYEG, IP-08cFNYEG, IP-08eFNYEG

Faculty member responsible for the course: Hunyadvári László

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	1	1
Type of testing	combined		

Topics:

Fundamental notions of formal language theory (alphabet, word, language, language family, operations on words and languages).

Constructive methods of description of languages (pure listing, logical formula, structural recursion, partial decision algorithms, enumeration, mathematical machines, formal grammars).

The generative grammar, examples, classification of grammars and languages. Restricted versions of grammars, normal forms.

The Chomsky-hierarchy of languages, the limits of description by grammars, the Church-thesis.

Relation between Chomsky-families and language operations.

The word-problem and its decision on Chomsky-families.

Finite automaton models, their equivalence, examples.

Type 3 languages and their related automata. Properties of type 3 languages.

Synthesis, analysis and minimization of automata. Applications of finite automata.

Context-free languages, their properties. Practical tools for definition of programming languages (BNF, EBNF, syntax-graphs).

Push-down automata. Relation between push-down automata and context-free languages.

The general top-down and the bottom-up parsing with back-tracking, Deterministic parsers.

Literature:

Arto Salomaa: Formal Languages (Academic Press, 1973)
J.E. Hopcroft, J.D. Ullman: Introduction to Automata Theory, Languages Computation (Addison Wesley, 1979)
A. V. Aho, R. Sethi, J. D. Ullman: Compilers - Principles, Techniques, and Tools (Addison Wesley, 1986)
Révész György: Bevezetés a formális nyelvek elméletébe (Akadémiai Kiadó, 1979)
Fülöp Zoltán: Formális nyelvek és szintaktikus elemzésük (Polygon jegyzettár, 1999)
Hunyadvári László: Formális nyelvek (2006, elektronikus jegyzet)

Recommended literature:

Csörnyei Zoltán: Bevezetés a fordítóprogramok elméletébe, I., II. (Nemzeti Tankönyvkiadó, Budapest, 1996)
Demetrovics János, Jordan Denev, Anton Pavlov: A számítástudomány matematikai alapjai (Tankönyvkiadó, Budapest, 1985)
M. A. Harrison: Introduction to Formal Language Theory (Addison Wesley, 1978)
J. E. Hopcroft, A. V. Aho: Introduction to Automata Theory, Languages, and Computation (Addison Wesley, 1979)
Salomaa, G. Rozenberg (Editors): The Handbook of Formal Languages I., II. (Springer Publishing Company, 1997)

Name of the course: Artificial intelligence

Course code: IP-08aMIAE, IP-08bMIAE, IP-08cMIAE, IP-08tMIAE, IP-08eMIAE

Faculty member responsible for the course: Gregorics Tibor

Total credits: 3

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2		1
Hours per week	2		1
Type of testing	exam		

Topics:

Problem modeling and graph representation. State-space representation. Solving problems by irrevocable searches: hill-climbing search, tabu search, algorithm of simulated annealing, genetic algorithms.
Tentative searches: backtracking, heuristic graph-search methods.
Decomposition and AND/OR graphs. Two-player games.
Logical reasoning by resolution and rule based systems.
Reasoning by uncertain knowledge. Probabilistic reasoning systems. Semantic nets and frames.
Decision trees, machine learning general logical formulas, artificial neural networks.

Literature:

N. J. Nilsson: Principles of Artificial Intelligence (Springer-Verlag, 1982)
E. Rich, K. Knigth: Artificial Intelligence (MacGraw-Hill Book Company, 1991)
N. J. Nilsson: Artificial Intelligence: a new synthesis (Morgan Kaufmann Pub. 1998)
Fekete I., Gregorics T., Nagy S.: Bevezetés a Mesterséges Intelligenciába (LSI, 1990, 1999)
Futó I. (szerk.): Mesterséges intelligencia (Aula Kiadó, 1999)
Russel, J. S., Norvig, P.: MI - modern megközelítésben (Panem Kft, 2000)
Gregorics Tibor: Mesterséges intelligencia (ELTE IK Digitális Könyvtár 2008)

Recommended literature:

M.R. Genesereth, N.J. Nilsson: Logical Foundations of Artificial Intelligent (Morgan Kaufmann Pub. 1987)
Mérő L.: Észjárások (TypoTEX, 1994)

Name of the course: Methodical bases of programming 1

Course code: IP-08bPMA1E, IP-08bPMA1G

Faculty member responsible for the course: Fóthi Ákos

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	1	1
Type of testing	exam	practice	

Topics:

State space, problem, program, solution, extension of problem and program, extension theorems, extension of the notion of solution, weakest precondition, variable, theorem of specification. Sequential programs: sequence, branch, loop; deduction rules, elemental programs. Type specifications, notable types.

Simple programming theorems (summation, counting, maximum search, conditional maximum search, linear search)

Literature:

E. W. Dijkstra: A discipline of programming (Englewood Cliffs, NJ: Prentice-Hall, 1976)
Fóthi Á.: Bevezetés a programozáshoz (Eötvös Kiadó, 2005)

Recommended literature:

DAHL, DIJKSTRA, HOARE: Strukturált programozás (Műszaki Könyvkiadó, 1978)
N. Wirth: Algoritmusok + Adatstruktúrák = Programok (Műszaki Könyvkiadó 1982)

Name of the course: Methodical bases of programming 2

Course code: IP-08bPMA2E, IP-08bPMA2G

Faculty member responsible for the course: Fóthi Ákos

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	1	1
Type of testing	exam	practice	

Topics:

Solving strategies (deduction, reduction, transformation; data abstraction, function abstraction).
Programming theorems: function substitution value (composition, case separation, recursion), element wise processing (definition, single variable, double variable, general), backtracking search and counting, logarithmic search.
Program transformations (not allowed conditions, simultaneous assignment, function substitution with variable, recursive function substitution with variable, program inversion).
Type transformations (function, function type, vector, set, sequence, file).
Examples of state space transformation, abstraction strategies (actualization: definitions, solutions in case of unique key, solutions in case of not unique key).
Connection to important programming paradigms.

Literature:

E. W. Dijkstra: A discipline of programming (Englewood Cliffs, NJ: Prentice-Hall, 1976)
Fóthi Á.: Bevezetés a programozáshoz (Eötvös Kiadó, 2005)

Recommended literature:

DAHL, DIJKSTRA, HOARE: Strukturált programozás (Műszaki Könyvkiadó, 1978)
N. Wirth: Algoritmusok + Adatstruktúrák = Programok (Műszaki Könyvkiadó 1982)

Name of the course: Practical software engineering 1

Course code: IP-08cPROGT1EG

Faculty member responsible for the course: Sike Sándor

Total credits: 6

Total hours: 5

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	3	2	1
Type of testing	combined		

Topics:
History of object-oriented programming. Object-oriented languages, Java. Object-oriented modelling, UML. Class diagram, object diagram, relations (association, aggregation, composition, inheritance). State-chart diagram, sequence diagram, collaboration diagram, activity diagram. Use-case diagram. Component diagram, packages. Implementation of object-oriented modells.

Literature:
Ian Sommerville: Software engineering, Pearson Education Limited, Eight edition, 2007, ISBN 13: 978-0-321-31379-9
Bruce Eckel: Thinking in Java, 3. kiadás (internetről szabadon letölthető)
Sike S., Varga L.: Szoftvertechnológia és UML (ELTE-Eötvös kiadó, 2003)

Recommended literature:

Name of the course: Practical software engineering 1

Course code: IP-08ePROGT1EG

Faculty member responsible for the course: Sike Sándor

Total credits: 5

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	1	2
Type of testing	combined		

Topics:
History of object-oriented programming. Object-oriented languages, Java. Object-oriented modelling, UML. Class diagram, object diagram, relations (association, aggregation, composition, inheritance). State-chart diagram, sequence diagram, collaboration diagram, activity diagram. Use-case diagram. Component diagram, packages. Implementation of object-oriented modells.

Literature:
Ian Sommerville: Software engineering, Pearson Education Limited, Eight edition, 2007, ISBN 13: 978-0-321-31379-9
Bruce Eckel: Thinking in Java, 3. kiadás (internetről szabadon letölthető)
Sike S., Varga L.: Szoftvertechnológia és UML (ELTE-Eötvös kiadó, 2003)

Recommended literature:

Name of the course: Practical software engineering 2

Course code: IP-08cPROGT2EG

Faculty member responsible for the course: Sike Sándor

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	1	1
Type of testing	combined		

Topics:
Design and implementation of GUI. Concurrency in Java. Access of databases through JDBC. Programming of mobile telephones in Java ME. Role and use of patterns in software development.

Literature:
Ian Sommerville: Software engineering, Pearson Education Limited, Eight edition, 2007, ISBN 13: 978-0-321-31379-9
Bruce Eckel: Thinking in Java, 3. kiadás (internetről szabadon letölthető)
Sike S., Varga L.: Szoftvertechnológia és UML (ELTE-Eötvös kiadó, 2003)

Recommended literature:

Name of the course: Practical software engineering 2

Course code: IP-08ePROGT2EG

Faculty member responsible for the course: Sike Sándor

Total credits: 5

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	1	2
Type of testing	combined		

Topics:
Design and implementation of GUI. Concurrency in Java. Access of databases through JDBC. Programming of mobile telephones in Java ME. Role and use of patterns in software development.

Literature:
Ian Sommerville: Software engineering, Pearson Education Limited, Eight edition, 2007, ISBN 13: 978-0-321-31379-9
Bruce Eckel: Thinking in Java, 3. kiadás (internetről szabadon letölthető)
Sike S., Varga L.: Szoftvertechnológia és UML (ELTE-Eötvös kiadó, 2003)

Recommended literature:

Name of the course: Programming languages (Ada)

Course code: IP-08aPNY2EG, IP-08bPNY2EG

Faculty member responsible for the course: Kozsik Tamás

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	combined		

Topics:

The students should learn the main concepts of programming languages and understand the constructs in (imperative) programming languages. An emphasis is given on language constructs affecting software quality (safety, robustness, maintainability, reusability, efficiency etc). As a concrete language, Ada is used both for illustration purposes and for the practicals, and the students are also referred to C++, which they have a basic knowledge of. The role of syntax and static/dynamic semantics is addressed. The main focus is on types, abstraction, generic programming and multithreading. The following topics are covered. Expressions and their evaluation, types and type constructors, statements and control structures, procedures and functions, parameter passing, overloading and overriding, program structures, scope and visibility, memory management, exception handling, encapsulation, type derivation, parametrized types, generics, scheduling of threads, interference, synchronization, deadlock, communication. On the practicals the students use Ada to exercise the language constructs presented on the lectures.

Literature:

John Barnes: Programming in Ada 2005. Addison Wesley, 2006.

Recommended literature:

Feldman, M. B., Koffman, E. B.: Ada 95: Problem Solving and Program Design (3rd Edition). Pearson Addison Wesley, 1999.

Ada Language Reference Manual, ISO/IEC 8652:2007(E) Ed. 3.
http://www.adaic.org/standards/05rm/html/RM-TTL.html

Name of the course: Programming Languages (C++)

Course code: IP-08bPNY1EG, IP-08cPNY1EG, IP-08tPNY1EG, IP-08ePNY1EG

Faculty member responsible for the course: Nyékyné Gaizler Judit, Porkoláb Zoltán

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	combined		

Topics:

Bases of the programming languages: syntax, semantics, interpreter, compiler, byte-code, compilation unit, specification, body, declarations, definitions, scope, life, visibility, global and local variables, block structure, strongly-typed languages, parameter-passing, parameters and arguments, default parameters.

Mathematical computations in FORTRAN. The structure of the C++ programming language. Preprocessor. Constants, types, differences between C and C++, operators, evaluation of expressions, different ways to handle memory. Dynamic declarations. Type conversion.

Functions, overloading, parameter passing, default parameters, references.

Object-oriented programming in C++: classes, members, constructors, destructors, static members, access modifiers, namespaces, operators. Inheritance, multiple inheritance, hiding, polimorphism, late and early binding in C++, abstract classes and interfaces. Exception handling. Template functions and template classes. The Standard Template Library and its usage. Role of functors

Literature:

Bjarne Stroustrup: The C++ Programming Language: Special Edition, Addison-Wesley Professional; 3 edition (February 11, 2000), ISBN-10: 0201700735, ISBN-13: 978-0201700732

Scott Meyers: Effective C++: 55 Specific Ways to Improve Your Programs and Designs (3rd Edition), Addison-Wesley Professional; 3 edition (May 22, 2005), ISBN-10: 0321334876, ISBN-13: 978-0321334879

Recommended literature:

Bjarne Stroustrup: Programming: Principles and Practice Using C++, Addison-Wesley Professional; 1 edition (December 25, 2008), ISBN-10: 0321543726, ISBN-13: 978-0321543721

Name of the course: Programming Languages (C++)

Course code: IP-08bPNY1EG, IP-08cPNY1EG, IP-08tPNY1EG, IP-08ePNY1EG

Faculty member responsible for the course: Nyékyné Gaizler Judit, Porkoláb Zoltán

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	combined		

Topics:

Bases of the programming languages: syntax, semantics, interpreter, compiler, byte-code, compilation unit, specification, body, declarations, definitions, scope, life, visibility, global and local variables, strongly-typed languages, parameter-passing, parameters and arguments, default parameters.

Preprocessor. Constants, types, differences between C and C++, operators, evaluation of expressions, different ways to handle memory.

Functions, overloading, parameter passing, default parameters, references.

Object-oriented programming in C++: classes, members, constructors, destructors, static members, access modifiers, namespaces, operators. Inheritance, multiple inheritance, hiding, polimorphism, abstract classes and interfaces. Exception handling. Template functions and template classes, template metaprogramming. The Standard Template Library and its usage

Literature:

Bjarne Stroustrup: The C++ Programming Language: Special Edition, Addison-Wesley Professional; 3 edition (February 11, 2000), ISBN-10: 0201700735, ISBN-13: 978-0201700732

Scott Meyers: Effective C++: 55 Specific Ways to Improve Your Programs and Designs (3rd Edition), Addison-Wesley Professional; 3 edition (May 22, 2005), ISBN-10: 0321334876, ISBN-13: 978-0321334879

Recommended literature:

Bjarne Stroustrup: Programming: Principles and Practice Using C++, Addison-Wesley Professional; 1 edition (December 25, 2008), ISBN-10: 0321543726, ISBN-13: 978-0321543721

Name of the course: Programming languages (Java)

Course code: IP-08cPNY2EG, IP-08tPNY2EG

Faculty member responsible for the course: Kozsik Tamás

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	combined		

Topics:

The students should learn the main concepts of programming languages and get acquainted with the constructs in imperative class-based object-oriented languages. As a concrete language, Java is used both for illustration purposes and for the practicals. The following topics are covered. Imperative programming (types, variables, operators, expressions, evaluation, statements and control structures, comments). Procedural programming (subprograms/methods, parameter passing, overloading, execution stack, recursion, exception handling). The main focus is on OOP (class, object, instantiation, members, constructors and initialization, access control, encapsulation and abstraction, inheritance, inclusion polymorphism, overriding, static and dynamic binding, static and dynamic types, abstract types, comparing and cloning objects). Concerning types, we discuss arrays, enumerations and generic programming. Program structures are also addressed: scope and visibility, memory management and garbage collection, name spaces, compilation units, nesting types. A brief introduction to multithreading and synchronization issues is given. Java-specific program execution model is also covered: virtual machine, class loading, JIT compilation. On the practicals students improve programming skills and exercise the use of some Java standard libraries such as data structures, streams and GUI.

Literature:

Cay S. Horstman, Gary Cornell: Core Java™, Volume 1 - Fundamentals (8th edition). Prentice Hall, 2007.

Recommended literature:

Gosling, J., Joy, B., Steele, G., Bracha, G: The Java™ Language Specification. Addison

Wesley, 2005 (Third Edition).
http://java.sun.com/docs/books/jls/

Gilad Bracha: Generics in the Java Programming Language. 2004.
http://java.sun.com/j2se/1.5/pdf/generics-tutorial.pdf

Name of the course: Programming languages (JAVA)

Course code: IP-08ePNY2EG

Faculty member responsible for the course: Kozsik Tamás

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	2	2
Type of testing	combined		

Topics:

The purpose of this course is to explain and practice the concepts and general terminology of programming languages, and to present the language constructs typical in the imperative object-oriented programming paradigm. As an illustration, the Java language is chosen. We address imperative programming (types, variables, operators, expressions, statements, control structures, comments), procedural programming (subprograms/methods, parameter passing, overloading, execution stack, recursion), and – with the strongest emphasis – class based object-oriented programming (class, object, members, instantiation and initialization, inheritance, inclusion polymorphism, redefinition and redeclaration, static and dynamic binding, abstract types, comparing and copying objects). With respect to types, we discuss arrays, enumeration types, generic and parametrized types, generic programming. The investigation of program structure includes scopes and visibility, namespaces (e.g. Java packages), compilation units, nested type definitions. Exceptions and exception handling are covered in details. We also mention multithreading and synchronization issues. The students will learn the fundamentals of program execution (e.g. virtual machines, class loading, dynamic linking) as well. Furthermore, some important program libraries, such as data structures, stream-based IO and graphical user interfaces are used throughout the labs.

Literature:

Gosling, J., Joy, B., Steele, G., Bracha, G: The JavaTM Language Specification (Addison Wesley, 2005 (Third Edition))

Nyékyné G. Judit (szerk) és mások: Java 2 útikalauz programozóknak 5.0 I-II. (ELTE TTK Hallgatói Alapítvány, 2009)

Recommended literature:

http://java.sun.com/docs/books/jls/

Name of the course: Compilers

Course code: IP-08aFPE, IP-08aFPG, IP-08bFPE, IP-08bFPG, IP-08cFPE, IP-08cFPG, IP-08tFPE, IP-08tFPG

Faculty member responsible for the course: Csörnyei Zoltán

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

The goal of the course is to introduce the students to the basic concepts of compilers and to address the practical issues of compiler construction.

Lecture:
- structure and task of compilers
- methods for lexical analysis
- LL parsing
- LR parsing
- symbol table handling
- semantical analysis, ATGs
- assembly basics
- code generation for basic imperative language constructs
- some techniques for code optimization

Lab:
- exercises for lexical analysis, flex
- exercises for LL parsing
- bisonc++
- exercises for LR parsing
- assembly programming exercises, NASM

Literature:

Dick Grune, Henri E. Bal, Ceriel J.H. Jacobs, Koen G. Langendoen: Modern Compiler Design, John Wiley & Sons LTD, 2003

Recommended literature:

Keith D. Cooper, Linda Torczon: Engineering a Compiler, Morgan Kaufmann Publishers, 2004

Randy Allen, Ken Kennedy: Optimizing Compilers for Modern Architectures, Morgan Kaufmann Publishers, 2002

Name of the course: Compilers

Course code: IP-08eFPE

Faculty member responsible for the course: Csörnyei Zoltán

Total credits: 3

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit	3		
Hours per week	2		1
Type of testing	exam		

Topics:

The goal of the course is to introduce the students to the basic concepts of compilers and to address the practical issues of compiler construction.

Lecture:
- structure and task of compilers
- methods for lexical analysis
- LL parsing
- LR parsing
- symbol table handling
- semantical analysis, ATGs
- assembly basics
- code generation for basic imperative language constructs
- some techniques for code optimization

Lab:
- exercises for lexical analysis, flex
- exercises for LL parsing
- bisonc++
- exercises for LR parsing
- assembly programming exercises, NASM

Literature:

Dick Grune, Henri E. Bal, Ceriel J.H. Jacobs, Koen G. Langendoen: Modern Compiler Design (John Wiley & Sons LTD, England, 2000, 2001, 2002, 2003)
Csörnyei Zoltán: Fordítóprogramok (Typotex, Budapest, 2006)

Recommended literature:

Name of the course: Operating Systems

Course code: IP-08aOPREG, IP-08bOPREG, IP-08cOPREG, IP-08eOPREG

Faculty member responsible for the course: Hunyadvári László

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	1	1
Type of testing	combined		

Topics:

Operating system concepts, its functions, its role in a computer system; firmware, middleware; interrupts, exceptions, system calls

Design goals, application categories, architectural concepts; application programming interface; examples

Process concepts and implementation; process descriptor, process table; thread concepts and different implementations; difference between thread and process; examples

Interactive, batch and real-time processes and their scheduling; scheduling algorithms; examples

Basic concepts and types of parallel execution, race condition; problem and solution of critical sections; shared memory and message passing; examples

Semaphores, monitors and their implementations; deadlocks, their characterization; deadlock-prevention, deadlock-avoidance and deadlock-detection; examples

Storage types, data-exchange between storages; the task of memory-management; basic memory-management methods: fixed and dynamic partitions; concept and implementation methods of virtual memory: paging and segmentation; examples

Virtual memory-management algorithms; anomalies; concept of working set, determination of optimal working-set size; examples

Input/output scheduling; scheduling algorithms; reduction of serving time by well chosen data-organization; disk space management; physical and logical formatting; partitions; redundant arrays (RAID levels, combi-RAID solutions); volume-management systems

File system services; files, meta-data, directories, links; special-purpose file systems; examples

File system implementation; overview; mounting; implementation of directories; block-allocation methods; free-storage management; journaling; examples

Security: security domains, access matrices, access-control- and capability-lists; security outlook; examples

Literature:

Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Concepts (Wiley Text Books, 2002)
Andrew S. Tanenbaum: Modern Operating Systems (Second Edition. Prentice Hall, 2001)
Andrew S. Tanenbaum –Albert S. Woodhull: Operációs rendszerek (Panem–Prentice Hall, 1999)
Kóczy Annamária – Kondorosi Károly: Operációs rendszerek mérnöki megközelítésben (Panem, 2000)
Pere László: UNIX – GNU/Linux Programozás C nyelven (Kiskapu, 2003)

Recommended literature:

Dr. Galambos Gábor: Operációs rendszerek (Műszaki könyvkiadó, 2003)
Horváth Gábor: Bepillantás az operációs rendszerek világába (LSI oktatóközpont, 2000)
Knapp Gábor: Operációs rendszerek (LSI oktatóközpont, 1999)
Bakos Tamás – Zsadányi Pál: Operációs Rendszerek (LSI oktatóközpont, 1989)
Daniel P. Bovet, Marco Cesati: Understanding the Linux Kernel (O'Reilly, 2000)
David A. Solmon, Mark E. Russinovich: Inside Microsoft Windows 2000 (Microsoft Press, 2000)
David D. Miller: OpenVMS Operating System Concepts (Second Edition. Digital Press, 1997)
Frank G. Soltis: Inside the AS/400 (Duke Press, 1996)
John Murray: Inside Microsoft Windows CE (Microsoft Press, 1998)

Name of the course: Computer Networks

Course code: IP-08aSZHE, IP-08aSZHG, IP-08bSZHE, IP-08bSZHG, IP-08cSZHE, IP-08cSZHG, IP-08tSZHE, IP-08tSZHE

Faculty member responsible for the course: Lukovszki Tamás

Total credits: 5

Total hours: 4

Type of the course	**Lecture**	**Practice**	**Consultation**
Credit	3	2	
Hours per week	2	2	1
Type of testing	Exam	practice	

Topics:

Introduction, Internet, network layers, reference models
Physical layer: Basics, limits on the data rate, self-clocking codes, baseband, broadband, modulation
Data link layer: error detection, error correction, Hamming distance, block codes, CRC, backward error correction, alternating bit protocol, sliding windows, MAC sublayer, static multiplexing, dynamic channel allocation, collision based protocols, Aloha, CSMA, contention free protocols, limited contention, Ethernet, LAN-interconnection
Network layer: link-state routing, distance-vector routing, RIP, IGRP, OSPF, inter-AS routing, BGP, IP addressing, CIDR, ARP, IPv6, DHCP, IPSec
Transport layer: multiplexing, TCP, Tahoe, Reno, AIMD, fairness
Network applications, socket programming
Application layer: DNS, Email, HTTP, WWW, P2P
Security: cryptology, firewalls

Literature:

Andrew S. Tanenbaum: Computer Networks. 4th edition (Prentice Hall, 2003)
Magyar fordítása: A. S. Tanenbaum: Számítógépes hálózatok, második, bővített átdolgozott kiadás (Panem, 2004)

Recommended literature:

James F. Kurose, Keith W. Ross: Computer Networking - A Top-Down Approach Featuring the Internet. 4th edition (Prentice Hall, 2007)

Magyar fordítása: J. F. Kurose, K. W. Ross: Számítógép hálózatok működése – Alkalmazásorientált megközelítés (Panem, 2008)

Larry L. Peterson, Bruce S. Davie: Computer Networks - A Systems Approach. 3rd edition (Morgan Kaufmann Publishers, 2003)

W. Richard Stevens: TCP/IP Illustrated, Volume I - The Protocols (Addison-Wesley, 1994)

Name of the course: Computer Networks

Course code: IP-08eSZHE, IP-08eSZHG

Faculty member responsible for the course: Lukovszki Tamás

Total credits: 5

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	1	2
Type of testing	exam	practice	

Topics:

Introduction, Internet, network layers, reference models
Physical layer: Basics, limits on the data rate, self-clocking codes, baseband, broadband, modulation
Data link layer: error detection, error correction, Hamming distance, block codes, CRC, backward error correction, alternating bit protocol, sliding windows, MAC sublayer, static multiplexing, dynamic channel allocation, collision based protocols, Aloha, CSMA, contention free protocols, limited contention, Ethernet, LAN-interconnection
Network layer: link-state routing, distance-vector routing, RIP, IGRP, OSPF, inter-AS routing, BGP, IP addressing, CIDR, ARP, IPv6, DHCP, IPSec
Transport layer: multiplexing, TCP, Tahoe, Reno, AIMD, fairness
Network applications, socket programming
Application layer: DNS, Email, HTTP, WWW, P2P
Security: cryptology, firewalls

Literature:

Andrew S. Tanenbaum: Computer Networks. 4th edition (Prentice Hall, 2003)
Magyar fordítása: A. S. Tanenbaum: Számítógépes hálózatok, második, bővített átdolgozott kiadás (Panem, 2004)

Recommended literature:

James F. Kurose, Keith W. Ross: Computer Networking - A Top-Down Approach Featuring the Internet. 4th edition (Prentice Hall, 2007)
Magyar fordítása: J. F. Kurose, K. W. Ross: Számítógép hálózatok működése – Alkalmazásorientált megközelítés (Panem, 2008)
Larry L. Peterson, Bruce S. Davie: Computer Networks - A Systems Approach. 3rd edition (Morgan Kaufmann Publishers, 2003)
W. Richard Stevens: TCP/IP Illustrated, Volume I - The Protocols (Addison-Wesley, 1994)

Name of the course: Fundaments of computing

Course code: IP-08SZGAEG

Faculty member responsible for the course: Istenes Zoltán

Total credits: 5

Total hours: 5

Type of the course	Lecture	Practice	Consultation
Credit	2	2	1
Hours per week	2	2	1
Type of testing	combined		

Topics:

Basic building blocks of computers, their logical and physical levels and their functionality. Multi processor and multicore systems. Data and program in the memory, instruction, data and number representation.

Operating systems, command line and graphical user interfaces, file systems, office program suites. The (secure) use of networked computers, required hardware and software tools.

The basic use of the networked computer.

Basic operating system script files, file management, process management and filtering.

Writing scripts, powershell basics and powershell scripts.

Literature:

Andrew S. Tanenbaum, Operating Systems: Design and Implementation, (co-authored with Albert Woodhull), ISBN 0-13-142938-8

Andrew S. Tanenbaum, Modern Operating Systems, ISBN 0-13-031358-0

Andrew S. Tanenbaum, Structured Computer Organization, ISBN 0-13-148521-0

Recommended literature:

http://szamalap.inf.elte.hu/

Name of the course: Computer Graphics

Course code: IP-aSZGE, IP-aSZGG, IP-cSZGE, IP-cSZGG, IP-tSZGE, IP-tSZGG

Faculty member responsible for the course: Csetverikov Dmitrij

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

Lectures:

- Representations of point, line and plane. Cartesian and homogenous coordinates
- Affine and projective transformations. Projections
- Geometric models in computer graphics
- Elements of the graphics pipeline

Practical classes:

- Elements and functions of graphical application programming interfaces,
- and their application (OpenGL and DirectX Graphics)

Abilities to form

- Understanding basic concepts, transformations, primitives, and
- fundamentals of geometric models, applied in computer graphics
- Knowledge and application of graphical API-s, and problem solving by using them

Literature:

Algorithms of Informatics (Ed.: A. Iványi), Vol. 2. Chapter 22.: Computer Graphics (L. Szirmay-Kalos) Bp., 2007.
J. D. Foley, A. van Dam, S. K. Feiner, J. F. Hughes: Computer Graphics: Principles and Practice in C (2nd Edition), Addison-Wesley Professional, 1995.
Farin,G.E., Hansford,D.: The Geometry Toolbox for Graphics and Modeling (A.K.Peters 1998)
Paul Martz: OpenGL, Distilled, Addison-Wesley, 2006.

Recommended literature:

Szirmay-Kalos László: Számítógépes grafika (Computerbooks, Budapest 2000)
Szirmay-Kalos László, Antal György, Csonka Ferenc: Háromdimenziós grafika, animáció és játékfejlesztés (Computerbooks, Budapest 2003)
Farin,G.E., Curves and Surfaces for CAGD (A Practical Guide, 5th ed., Morgan Kaufmann 2002)
Nyisztor Károly: Grafika és játékprogramozás DirectX-szel (SZAK Kiadó, Bicske 2005)

Name of the course: Tools of software projects

Course code: IP-08cPRJG

Faculty member responsible for the course: Porkoláb Zoltán

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week		2	
Type of testing		combined	

Topics:

Today software development is supported by a high number of software tools from make systems to source control. During this course students will learn the theoretical background and the practical usage of the most fundamental tools. Students will participate in the implementation of a smaller project and practice its maintenance. They became familiar with regular expressions, build systems (gmake). Using source and version control systems they learn how to work in small-medium sized teams. We overview the building life-cycle: compilation, linking, running/interpreting and getting familiar with the creation and usage of dynamic and static libraries, binary compatibility and patching issues. We will introduce some code quality metrics and learn refactoring techniques. Test tools and test methods will be emphasized and practiced. Students will meet with profiling and measuring tools and practicing performance increasing techniques. We will conclude with tools of documentation.

Literature:

Robert Mecklenburg, O'Reilly: Managing Projects with GNU Make (Nutshell Handbooks); 3 edition (November 19, 2004), ISBN-10: 0596006101, ISBN-13: 978-0596006105

Thorsten Grötker, Ulrich Holtmann, Holger Keding, Markus Wloka: The Developer's Guide to Debugging,. Springer; 1 edition (September 11, 2008) , ISBN-10: 1402055390, ISBN-13: 978-1402055393.

J Seward, N Nethercote, J Weidendorfer: Valgrind 3.3 - Advanced Debugging and Profiling for GNU/Linux applications. Network Theory Ltd. (March 1, 2008) ISBN-10: 0954612051, ISBN-13: 978-0954612054.

Recommended literature:

Lisa Crispin, Janet Gregory: Agile Testing: A Practical Guide for Testers and Agile Teams. Addison-Wesley Professional; 1 edition (January 9, 2009), ISBN-10: 0321534468 ISBN-13: 978-0321534460

Marnie L. Hutcheson: Software Testing Fundamentals: Methods and Metrics. Wiley; 1st edition (April 11, 2003), ISBN-10: 047143020X ISBN-13: 978-0471430209

Name of the course: Computer Graphics

Course code: IP-eSZGE, IP-eSZGG

Faculty member responsible for the course: Csetverikov Dmitrij

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	1	2	1
Type of testing	exam	practice	

Topics:

Lectures:

- Representations of point, line and plane. Cartesian and homogenous coordinates
- Affine and projective transformations. Projections
- Geometric models in computer graphics
- Elements of the graphics pipeline

Practical classes:

- Elements and functions of graphical application programming interfaces,
- and their application (OpenGL and DirectX Graphics)

Abilities to form

- Understanding basic concepts, transformations, primitives, and
- fundamentals of geometric models, applied in computer graphics
- Knowledge and application of graphical API-s, and problem solving by using them

Literature:

Algorithms of Informatics (Ed.: A. Iványi), Vol. 2. Chapter 22.: Computer Graphics (L. Szirmay-Kalos) Bp., 2007.
J. D. Foley, A. van Dam, S. K. Feiner, J. F. Hughes: Computer Graphics: Principles and Practice in C (2nd Edition), Addison-Wesley Professional, 1995.
Farin,G.E., Hansford,D.: The Geometry Toolbox for Graphics and Modeling (A.K.Peters 1998)
Paul Martz: OpenGL, Distilled, Addison-Wesley, 2006.

Recommended literature:

Szirmay-Kalos László: Számítógépes grafika (Computerbooks, Budapest 2000)
Szirmay-Kalos László, Antal György, Csonka Ferenc: Háromdimenziós grafika, animáció és játékfejlesztés (Computerbooks, Budapest 2003)
Farin,G.E., Curves and Surfaces for CAGD (A Practical Guide, 5th ed., Morgan Kaufmann 2002)
Nyisztor Károly: Grafika és játékprogramozás DirectX-szel (SZAK Kiadó, Bicske 2005)

Name of the course: Software Technology

Course code: IP-08aSZTE, IP-08bSZTE, IP-08tSZTE

Faculty member responsible for the course: Sike Sándor

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	1	1
Type of testing	combined		

Topics:

History and aims of software technology. Software development modells, phases of software development. Object-oriented modelling, UML. Class diagram, object diagram, relations (association, aggregation, composition, inheritance). State-chart diagram, sequence diagram, collaboration diagram, activity diagram. Use-case diagram. Component diagram, packages. Quality of softwares.

Literature:

Ian Sommerville: Software engineering , Pearson Education Limited, Eight edition, 2007, ISBN 13: 978-0-321-31379-9

Bruce Eckel: Thinking in Java, 3. kiadás (Internetről szabadon letölthető)

Sike S., Varga L.: Szoftvertechnológia és UML (ELTE-Eötvös kiadó, 2003)

Recommended literature:

Name of the course: Models and Algorithms

Course code: IP-08bMODAL

Faculty member responsible for the course: Szili László

Total credits: 3

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		3	
Hours per week		1	1
Type of testing		practice	

Topics:

The notion of the implicit function and its role in the solution of the system of equations.
The implicit and the inverse function theorems.
Constrained extrema of functions of several variables.
The notion of ordinary differential equations. Separable, exact and linear equations.
The theorem of Picard-Lindelöf, the successive approximation.
Linear system of differential equation with constant coefficients.
Higher-order linear differential equation with constant coefficients.
Sequences and series of functions.
Convergence, uniform convergence. The Weierstrass theorem.
The continuity, integrability, differentiability of the limit function.
The orthogonality of the trigonometric system. Uniformly convergent trigonometric series.
Fourier coefficients, Fourier series, partial sums of Fourier series. The minimum property of the partial sums of the Fourier series, the Bessel identity, the Bessel inequality, the Parseval formula. Fourier series of differentiable functions.
The problem of the vibrating chord.

Literature:

W. Rudin: Principles of Mathematical Analysis (McGraw-Hill. Inc., New York-Toronto-London, 1965)
E.A. Coddington, N. Levinson, The Theory of Ordinary Differential Equations (McGraw-Hill. Inc., New York-Toronto-London, 1955)
Tóth János, Simon L. Péter: Differenciálegyenletek (TYPOTEX Kiadó, Budapest, 2005)
Pontrjagin, L.Sz. Közönséges differenciálegyenletek (Akadémiai Kiadó, Budapest, 1972.)
K. K. Ponomarjov: Differenciálegyenletek felállítása és megoldása (Tankönyvkiadó, Budapest, 1969)
Leindler László, Schipp Ferenc: Analízis I. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: Analízis II. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: Analízis feladatokban I. (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:

Molnárka Győző, Gergó Lajos, Wettl Ferenc, Horváth A., Kallós Gábor: MapleV és alkalmazásai (Springer Hungarica Kiadó, Budapest, 1996)
Simon Péter: Fejezetek az analízisből (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
Stoyan G. (szerk.) MATLAB (TYPOTEX Kiadó, Budapest, 1999)
Szili László, Tóth János: Matematika és Mathematica (ELTE Eötvös Kiadó, Budapest, 1996)

Name of the course: Models and Algorithms

Course code: IP-08cMODAL, IP-08eMODAL

Faculty member responsible for the course: Szili László

Total credits: 3

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		3	
Hours per week		2	1
Type of testing		practice	

Topics:

The notion of the implicit function and its role in the solution of the system of equations.
The implicit and the inverse function theorems.
Constrained extrema of functions of several variables.
The notion of ordinary differential equations. Separable, exact and linear equations.
The theorem of Picard-Lindelöf, the successive approximation.
Linear system of differential equation with constant coefficients.
Higher-order linear differential equation with constant coefficients.
Sequences and series of functions.
Convergence, uniform convergence. The Weierstrass theorem.
The continuity, integrability, differentiability of the limit function.
The orthogonality of the trigonometric system. Uniformly convergent trigonometric series.
Fourier coefficients, Fourier series, partial sums of Fourier series. The minimum property of the partial sums of the Fourier series, the Bessel identity, the Bessel inequality, the Parseval formula. Fourier series of differentiable functions.
The problem of the vibrating chord.

Literature:

W. Rudin: Principles of Mathematical Analysis (McGraw-Hill. Inc., New York-Toronto-London, 1965)
E.A. Coddington, N. Levinson, The Theory of Ordinary Differential Equations (McGraw-Hill. Inc., New York-Toronto-London, 1955)
Tóth János, Simon L. Péter: Differenciálegyenletek (TYPOTEX Kiadó, Budapest, 2005)
Pontrjagin, L.Sz. Közönséges differenciálegyenletek (Akadémiai Kiadó, Budapest, 1972.)
K. K. Ponomarjov: Differenciálegyenletek felállítása és megoldása (Tankönyvkiadó, Budapest, 1969)
Leindler László, Schipp Ferenc: Analízis I. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1976)
Pál Jenő, Schipp Ferenc, Simon Péter: Analízis II. (egyetemi jegyzet, Tankönyvkiadó, Budapest, 1982)
Szili László: Analízis feladatokban I. (ELTE Eötvös Kiadó, Budapest, 2008)

Recommended literature:

Molnárka Győző, Gergó Lajos, Wettl Ferenc, Horváth A., Kallós Gábor: MapleV és alkalmazásai (Springer Hungarica Kiadó, Budapest, 1996)
Simon Péter: Fejezetek az analízisből (egyetemi jegyzet, ELTE Természettudományi Kar, Budapest, 1997)
Stoyan G. (szerk.) MATLAB (TYPOTEX Kiadó, Budapest, 1999)
Szili László, Tóth János: Matematika és Mathematica (ELTE Eötvös Kiadó, Budapest, 1996)

Name of the course: Packages in Numerical Methods

Course code: IP-08cNM2EG

Faculty member responsible for the course: Krebsz Anna

Total credits: 4

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		4	
Hours per week		2	2
Type of testing		practice	

Topics:

Iterative solution of nonlinear equations: secant and bisection method, fixed point iteration, Newton's method.

Polynomial interpolation: Lagrange form, divided difference form, error of the interpolation, Hermite interpolation, Spline interpolation.

Least squares approximation to discrete data.

Numerical integration: Newton Cotes formulas, composite forms.

Literature:

Hammerlin-Hoffmann, Numerical Mathematics (Springer, 1991)
Süli-Mayers, An Introduction to Numerical Analysis (Cambridge, 2003)

Recommended literature:

Stoer-Bulirsch, Introduction to Numerical Analysis (Springer, 1980)

Name of the course: Packages in Numerical Methods

Course code: IP-08eNM2EG

Faculty member responsible for the course: Krebsz Anna

Total credits: 3

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		3	
Hours per week		2	1
Type of testing		practice	

Topics:
Iterative solution of nonlinear equations.

Polynomial interpolation: Lagrange form, divided difference form, error of the interpolation, Hermite interpolation, spline interpolation.

Least squares approximation to discrete data.

Numerical integration: Newton Cotes formulas, composite forms.

Literature:
Hammerlin-Hoffmann, Numerical Mathematics (Springer, 1991)
Süli-Mayers, An Introduction to Numerical Analysis (Cambridge, 2003)

Recommended literature:
Stoer-Bulirsch, Introduction to Numerical Analysis (Springer, 1980)

Name of the course: Mathematics II 1

Course code: IP-08tMATII1E, IP-08tMATII1G

Faculty member responsible for the course: Járai Antal

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

Graphs. Basic concepts: vertex, edge, path, cycle. Connectedness, trees, forests, spanning trees. Eulerian and Hamiltonian paths. Planar graphs. Digraphs. Algebraic structures. Semigroups, groups. Subgroup, Lagrange's theorem. Generated subgroup. Normal subgroups, homomorphisms. Rings, ideals, quotient rings. Polynomials, division, ideals in polynomial rings. Fields, finite fields. Coding. Uniquely decomposable codes. Prefix code, code tree. The Kraft-McMillan theorem. Source coding, expected word length, optimal code, entropy, Shannon's theorem. Huffman code. LZW.

Literature:

R. Graham, D. E. Knuth, O. Patashnik: Concrete Mathematics
D. E. Knuth: The Art of Computer Programming
N. L. Biggs: Discrete Mathematics
Járai Antal: Bevezetés a matematikába (Eötvös Kiadó, Budapest, 2007)

Recommended literature:

Name of the course: Matematika II 2 EA

Course code: IP-08tMATII2E

Faculty member responsible for the course: Járai Antal

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit	2		
Hours per week	2		
Type of testing	exam		

Topics:
History of probability theory.
The algebra of events.
Classical definition of probability.
Combinatorial probability, geometric probability.
Conditional probability, law of total probability, Bayes' theorem.
Random variable, distribution and density functions.
Particular distributions.
Moments.
Law of large numbers.
Central limit theorem.

Literature:
John Wiley & Sons: An Introduction to Probability Theory and Mathematical Statistics (Paperback, March 1976)

Recommended literature:

Name of the course: Discrete mathematics 1

Course code: IP-08DM1E, IP-08DM1G

Faculty member responsible for the course: Járai Antal

Total credits: 7

Total hours: 6

Type of the course	Lecture	Practice	Consultation
Credit	4	3	
Hours per week	3	3	1
Type of testing	exam	practice	

Topics:

Logical operations, quantifiers, formulas. Sets, set operations, subsets. Binary relations, equivalence relation, equivalence classes, partial ordering. Functions, Cartesian product of sets, general relations, connection to relational data bases. Binary operations, operations in general, logical operations.

Peano-axioms, natural numbers, induction, recursion. Operations with natural numbers, ordering of natural numbers. Semigroup, unit element, group, Abelian group.

Numbers: integers, rational numbers, real and complex numbers, quaternions. Ring, integral domain, skew field, field.

Finite sets. Combinations, permutation. Polynomial theorem, sieve formulae.

Divisor, prime and irreducible numbers. Divisibility in rings. Euclidean algorithm. Basic theorem of number theory. Congruencies, Diophantine equations and their solution in linear case. Chinese remainder theorem. Diffie-Hellmann key exchange, RSA system. Number theoretical functions.

Infinite sets: Cantor-Bernstein theorem, Cantor's theorem. Countable sets and their characterizations. Sets with cardinality of continuum.

Literature:

R. Graham, D. E. Knuth, O. Patashnik: Concrete Mathematics
D. E. Knuth: The Art of Computer Programming
N. L. Biggs: Discrete Mathematics
Járai Antal: Bevezetés a matematikába (Eötvös Kiadó, Budapest, 2007)

Recommended literature:

Láng Csabáné: Bevezetés a matematikába
Dringó- Kátai: Bevezetés a matematikába
Szendrei Ágnes: Diszkrét matematika

Name of the course: Discrete mathematics 1

Course code: IP-08eDM1E, IP-08eDM1G

Faculty member responsible for the course: Járai Antal

Total credits: 6

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	1	3
Type of testing	exam	practice	

Topics:

Logical operations, quantifiers, formulas. Sets, set operations, subsets. Binary relations, equivalence relation, equivalence classes, partial ordering. Functions, Cartesian product of sets, general relations, connection to relational data bases. Binary operations, operations in general, logical operations.

Peano-axioms, natural numbers, induction, recursion. Operations with natural numbers, ordering of natural numbers. Semigroup, unit element, group, Abelian group.

Numbers: integers, rational numbers, real and complex numbers, quaternions. Ring, integral domain, skew field, field.

Finite sets. Combinations, permutation. Polynomial theorem, sieve formulae.

Divisor, prime and irreducible numbers. Divisibility in rings. Euclidean algorithm. Basic theorem of number theory. Congruencies, Diophantine equations and their solution in linear case. Chinese remainder theorem. Diffie-Hellmann key exchange, RSA system. Number theoretical functions.

Infinite sets: Cantor-Bernstein theorem, Cantor's theorem. Countable sets and their characterizations. Sets with cardinality of continuum.

Literature:

R. Graham, D. E. Knuth, O. Patashnik: Concrete Mathematics
D. E. Knuth: The Art of Computer Programming
N. L. Biggs: Discrete Mathematics
Járai Antal: Bevezetés a matematikába (Eötvös Kiadó, Budapest, 2007)

Recommended literature:

Láng Csabáné: Bevezetés a matematikába
Dringó- Kátai: Bevezetés a matematikába
Szendrei Ágnes: Diszkrét matematika

Name of the course: Discrete mathematics 2

Course code: IP-08aDM2E, IP-08aDM2G, IP-08bDM2E, IP-08bDM2G, IP-08cDM2E, IP-08cDM2G

Faculty member responsible for the course: Járai Antal

Total credits: 6

Total hours: 6

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	3	
Type of testing	exam	practice	

Topics:

Graphs: examples, path, cycle. Isomorphic graphs, subgraphs, complement of a subgraph. Eulerian path, Hamilton-cycle. Labeled graphs, Kruskal's algorithm. Directed graphs, strongly connected graphs, directed trees and their applications. Planar graphs, the theorem of Kuratowski , Euler's theorem.

Groups, subgroup, normal subgroup, factorgroup the homomorphism theorem. Cyclic groups, permutation groups. Ring, subring, ideal, factorring, the homomorphism theorem.

Polynomials, the ring of polynomials, Euclidean rings, Euclidian algorithm. Finite fields, factorization of polynomials, rational functions. the theorem of Gauss. Polynomials with several indeterminants.

Information, bit, entropy. Compression, optimal character coding, other coding types and their applications. Error correcting codes, code distance, linear codes, MDS codes, Reed-Solomon code and it decoding.

Algorithms in general, simulation. Turing machines, the equivalence of their versions. RAM computer, Neumann-type computers, heir equivalence with Turing machines. Other models. Languages, decidability, computable and partially computable functions. Some undecidable problems. Nondeterministic Turing machines, the NP problem class.

Literature:

R. Graham, D. E. Knuth, O. Patashnik: Concrete Mathematics
D. E. Knuth: The Art of Computer Programming
N. L. Biggs: Discrete Mathematics
Járai Antal: Bevezetés a matematikába (Eötvös Kiadó, Budapest, 2007)

Recommended literature:
Láng Csabáné: Bevezetés a matematikába II
Dringó- Kátai: Bevezetés matematikába
Szendrei Ágnes: Diszkrét matematika
Gonda János: Bevezetés a matematikába III
Gonda János: Kódoláselmélet

Name of the course: Discrete mathematics 2

Course code: IP-08eDM2E, IP-08eDM2G

Faculty member responsible for the course: Járai Antal

Total credits: 6

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	1	3
Type of testing	exam	practice	

Topics:

Graphs: examples, path, cycle. Isomorphic graphs, subgraphs, complement of a subgraph. Eulerian path, Hamilton-cycle. Labeled graphs, Kruskal's algorithm. Directed graphs, strongly connected graphs, directed trees and their applications. Planar graphs, the theorem of Kuratowski , Euler's theorem.

Groups, subgroup, normal subgroup, factorgroup the homomorphism theorem. Cyclic groups, permutation groups. Ring, subring, ideal, factorring, the homomorphism theorem.

Polynomials, the ring of polynomials, Euclidean rings, Euclidian algorithm. Finite fields, factorization of polynomials, rational functions. the theorem of Gauss. Polynomials with several indeterminants.

Information, bit, entropy. Compression, optimal character coding, other coding types and their applications. Error correcting codes, code distance, linear codes, MDS codes, Reed-Solomon code and it decoding.

Algorithms in general, simulation. Turing machines, the equivalence of their versions. RAM computer, Neumann-type computers, heir equivalence with Turing machines. Other models. Languages, decidability, computable and partially computable functions. Some undecidable problems. Nondeterministic Turing machines, the NP problem class.

Literature:

R. Graham, D. E. Knuth, O. Patashnik: Concrete Mathematics
D. E. Knuth: The Art of Computer Programming
N. L. Biggs: Discrete Mathematics
Járai Antal: Bevezetés a matematikába (Eötvös Kiadó, Budapest, 2007)

Recommended literature:
Láng Csabáné: Bevezetés a matematikába II
Dringó- Kátai: Bevezetés matematikába
Szendrei Ágnes: Diszkrét matematika
Gonda János: Bevezetés a matematikába III
Gonda János: Kódoláselmélet

Name of the course: Discrete mathematics 3 EA

Course code: IP-eBM3E

Faculty member responsible for the course: Járai Antal

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit	2		
Hours per week	2		
Type of testing	exam		

Topics:

Field extensions, degree of an extension, degree theorem. Algebraic and transcendental numbers and extensions. Prime fields, finite fields. Minimal polynomial, factorring with respect to irreducible polynomial, construction of finite fields, the multiplicative group of nonzero elements. Data compression: prefix code, McMillan's inequality, theorem of Kraft. Optimal code, entropy, Shannon's theorem, Huffman-code, LZW-algorithm. Error correcting codes: Hamming-distance, weight. Minimal distance decoding. Hamming's bound. Linear codes and matrices. Singleton's bound. Hamming code, BCH-code, polynomial codes. Turing machines, variants. Nondeterministic Turing machines. RAM machines. Church thesis. Recursive, etc. languages. Algorithmically unsolvable problems. O, o, P and NP.

Literature:

R. Graham, D. E. Knuth, O. Patashnik: Concrete Mathematics
D. E. Knuth: The Art of Computer Programming
N. L. Biggs: Discrete Mathematics
Járai Antal: Bevezetés a matematikába (második kiadás, 2006)

Recommended literature:

Gonda János: Bevezető fejezetek a matematikába III. (egyetemi jegyzet)

Name of the course: Application Development

Course code: IP-08cALKEG

Faculty member responsible for the course: Gregorics Tibor

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit			
Hours per week	1	1	
Type of testing		practice	

Topics:
Application development in Java Standard Edition
GUI designers
JavaBeans component development
dbSwing components
Client-server applications

Literature:
Cay S. Horstmann, Gary Cornell: Core Java, Volume II: Advanced Features

Recommended literature:

Name of the course: Algorithms and data structures I.

Course code: IP-08aAA1E, IP-08aAA1G, IP-08bAA1E, IP-08bAA1G, IP-08cAA1E, IP-08cAA1G

Faculty member responsible for the course: Fekete István

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

I. Fundamentals

1. Running time of algorithms; 2. Abstraction levels of data types

II. Basic data structures

3. Arrays; 4. Stacks; 5. Queues; 6. Priority queues; 7. Lists; 8. Trees

III. Search trees

9. Binary search trees; 10. AVL-trees; 11. 2-3-trees and B-trees

IV. Sorting

12. Bubble sort, insertion sort and sorting with maximum search; 13. Tournament sort; 14. Heapsort; 15. Quicksort; 16. Merge sort; 17. Lower bound for running time of sorting algorithms with comparisons: worst case and average case analysis

Literature:

Cormen, Leiserson, Rivest, Stein: Introduction to algorithms. MIT Press, 2001.

Recommended literature:

Name of the course: Algorithms and data structures II.

Course code: IP-08aAA2E, IP-08aAA2G, IP-08bAA2E, IP-08bAA2G, IP-08cAA2E, IP-08cAA2G

Faculty member responsible for the course: Fekete István

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

I. Hash coding

1. Hash tables, hash functions, open addresses ; 2. Sorting in linear time: Radix sort, bucket sort

II. Graph algorithms

3. Representation of graphs; 4. Breadth-first search; 5. Single source shortest paths: Dijkstra's algorithm, Bellman-Ford algorithm; 6. Minimum spanning trees: algorithms of Prim and Kruskal; 7. All pairs shortest pairs: Warshall-Floyd algorithm; 8. Depth-first search; 9. Topological sort; 10. Strongly connected components

III. Data compression

11. Huffman-coding; 12. Lempel-Ziv-Welch (LZW) algorithm

IV. String matching

13. Knuth-Morris-Pratt algorithm; 14. Quick search; 15. Rabin-Karp algorithm

Literature:

Cormen, Leiserson, Rivest, Stein: Introduction to algorithms. MIT Press, 2001.

Recommended literature:

Name of the course: Event-driven applications 1

Course code: IP-08bEVALK1EG

Faculty member responsible for the course: Gregorics Tibor

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week	1	1	
Type of testing		practice	

Topics:
Creating a simple windows forms applications (one-machine, one-user, event-driven applications with graphical user interface) on platform .NET/C#, Qt/C++ and Java ME. Configuring standard controls, using dialog boxes and other modal forms, customizing controls, starting other process, using graphics.

Literature:
Jasmin Blanchette, Mark Summerfield: C++ GUI Programming with Qt 4 (Prentice Hall, 2006)
MSDN Library for Visual Studio .NET 2005 (Microsoft Corporation, 2005)
MSDN Online: http://msdn.microsoft.com
www.msdn.com, www.trolltech.com
John Sharp: Visual C# 2005 lépésről lépésre (SZAK, 2005)
Forstner Bertalan, Ekler Péter, Kelényi Imre: Bevezetés a mobilprogramozásba (Szak Kiadó, 2008)

Recommended literature:
Bradley L. Jones: C# mesteri szinten (Kiskapu, 2004)
Illés Zoltán: Programozás C# nyelven (JOS, 2004)
Jason Price: C# adatbázisprogramozás (Kiskapu, 2004)
Sipos Marianna: Programozás élesben (InfoKit, 2004)
Albert István és társai: A .NET Framwork programozása (Szak kiadó, 2004)
Daniel Solin: Qt Programming (Sams 2000)

Name of the course: Event-driven applications 2

Course code: IP-08bEVALK2EG

Faculty member responsible for the course: Gregorics Tibor

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week	1	1	
Type of testing		practice	

Topics:
One-machine, one-user, event-driven applications with graphical user interface on platform .NET/C# and Qt/C++ being connected with a database server.
Creating connection, executing database commands, modeling a database in the memory, viewing data-tables, editing and updating data, MVC (model-view-control) architecture.

Literature:
Jasmin Blanchette, Mark Summerfield: C++ GUI Programming with Qt 4 (Prentice Hall, 2006)
MSDN Library for Visual Studio .NET 2005 Microsoft Corporation, 2005
MSDN Online: http://msdn.microsoft.com
www.msdn.com, www.trolltech.com
Jason Price: C# adatbázis programozás (Kiskapu, 2004)
Gregorics Tibor: Alkalmazások fejlesztése az ADO.NET-tel (ELTE IK Digitális Könyvtár 2008)
John Sharp: Visual C# 2005 lépésről lépésre (SZAK, 2005)

Recommended literature:
Bradley L. Jones: C# mesteri szinten (Kiskapu, 2004)
Illés Zoltán: Programozás C# nyelven (JOS, 2004)
Jason Price: C# adatbázisprogramozás (Kiskapu, 2004)
Sipos Marianna: Programozás élesben (InfoKit, 2004)
Albert István és társai: A .NET Framwork programozása (Szak kiadó, 2004)
Daniel Solin: Qt Programming (Sams 2000)

Name of the course: Development of object-oriented applications

Course code: IP-08bOEALKEG, IP-08aOEALKEG

Faculty member responsible for the course: Gregorics Tibor

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week	1	1	
Type of testing		practice	

Topics:
Construction of object-oriented programs. Pointers. Concept of classes (visibility, construction, destruction, operators, friend). Inheritance in code reusability. Support of analogous programming with reusability. Realisation of data structures with pointers. Templates,
Iterator template classes.

Literature:
Bjarne Stroustrup: A C++ programozási nyelv (Kiskapu)
Herbert Schildt: C/C++ Referenciakönyv (Panem Kft. 1998)

Recommended literature:

Name of the course: Programming A

Course code: IP-08aPROGEG

Faculty member responsible for the course: Gregorics Tibor

Total credits: 7

Total hours: 7

Type of the course	Lecture	Practice	Consultation
Credit	2	4	1
Hours per week	2	4	1
Type of testing	combined		

Topics:

The concept of programming based on programming patterns. Algorithm patterns (programming theorems) on functions mapping from an integer interval: summation, counting, maximum selection, selection, linear and logarithmic searching, conditional maximum searching, computing recursive function. Designing programs with analogous programming based on programming theorems and their implementation in language C++. Embedded analogous programming. Elimination of recursive functions. Functions and modules in C++. Data type and its implementation with class. Collections. General programming theorems on enumerators. Abstract enumerators.

Literature:

Herbert Schildt: C/C++ Referenciakönyv (Panem Kft. 1998)
Andrei Alexandrescu, Herb Sutter: C++ kódolási szabályok (Kiskapu Kft. 2005)
Kent Beck: Implementációs minták (Panem 2008)

Recommended literature:

Fóthi Ákos: Bevezetés a programozáshoz (ELTE Eötvös Kiadó. 2005)
Bjarne Stroustrup: A C++ programozási nyelv (Kiskapu)

Name of the course: Programming BT

Course code: IP-08bPROGEG

Faculty member responsible for the course: Gregorics Tibor

Total credits: 5

Total hours: 5

Type of the course	Lecture	Practice	Consultation
Credit	2	2	1
Hours per week	2	2	1
Type of testing	combined		

Topics:

The concept of programming based on programming patterns. Algorithm patterns (programming theorems) on functions mapping from an integer interval: summation, counting, maximum selection, selection, linear and logarithmic searching, conditional maximum searching, computing recursive function. Designing programs with analogous programming based on programming theorems and their implementation in language C++. Embedded analogous programming. Elimination of recursive functions. Functions and modules in C++. Data type and its implementation with class. Collections. General programming theorems on enumerators. Abstract enumerators.

Literature:

Herbert Schildt: C/C++ Referenciakönyv (Panem Kft. 1998)
Andrei Alexandrescu, Herb Sutter: C++ kódolási szabályok (Kiskapu Kft. 2005)
Kent Beck: Implementációs minták (Panem 2008)

Recommended literature:

Fóthi Ákos: Bevezetés a programozáshoz (ELTE Eötvös Kiadó. 2005)
Bjarne Stroustrup: A C++ programozási nyelv (Kiskapu)

Name of the course: Programming CE

Course code: IP-08cPROGEG IP-08ePROGEG

Faculty member responsible for the course: Gregorics Tibor

Total credits: 7

Total hours: 7

Type of the course	Lecture	Practice	Consultation
Credit	2	4	1
Hours per week	2	4	1
Type of testing	combined		

Topics:

The concept of programming based on programming patterns. Algorithm patterns (programming theorems) on functions mapping from an integer interval: summation, counting, maximum selection, selection, linear and logarithmic searching, conditional maximum searching, computing recursive function. Designing programs with analogous programming based on programming theorems and their implementation in language C++. Embedded analogous programming. Functions and modules in C++. Data type and its implementation with class. Collections. General programming theorems on enumerators.

Literature:

Herbert Schildt: C/C++ Referenciakönyv (Panem Kft. 1998)
Andrei Alexandrescu, Herb Sutter: C++ kódolási szabályok (Kiskapu Kft. 2005)
Kent Beck: Implementációs minták (Panem 2008)

Recommended literature:

Fóthi Ákos: Bevezetés a programozáshoz (ELTE Eötvös Kiadó. 2005)
Bjarne Stroustrup: A C++ programozási nyelv (Kiskapu)

Name of the course: Functional programming

Course code: IPb-08bFUNPEG

Faculty member responsible for the course: Horváth Zoltán

Total credits: 5

Total hours: 5

Type of the course	Lecture	Practice	Consultation
Credit	2	3	
Hours per week	2	2	1
Type of testing	combined		

Topics:

The course introduces the concepts of functional programming, computational model and elements of functional programming languages. Students get assignments in programming in Haskell and Clean.

The functional programming paradigm: referential transparency, evaluation, normal form, strictness analysis. The elements of the programming languages Clean and Haskell: function definitions, local definitions, higher order functions, patterns, guards modules. Simple data structures, lists, tuples, records, arrays, ZF expressions, filters. Type systems, polymorph types, algebraic types. Type classes, instances, interactive functional programs.

Literature:

Plasmeijer,R. et al.:Functional Programming in Clean, July 1999. Draft.,
http://www.cs.kun.nl/~clean/ .
Thompson, S.: Haskell, The Craft of Functional Programming. Addison-Wesley, 1999.

Recommended literature:

Peyton Jones, J., Hughes J., et al.: Report on the Programming Language Haskell 98, A Non-strict, Purely Functional Language, February 1999.

Name of the course: Functional programming

Course code: IPb-08tFUNPEG

Faculty member responsible for the course: Horváth Zoltán

Total credits: 5

Total hours: 5

Type of the course	Lecture	Practice	Consultation
Credit	2	3	
Hours per week	2	2	1
Type of testing	combined		

Topics:

The course introduces the concepts of functional programming, computational model and elements of functional programming languages. Students get assignments in programming in Haskell.

The functional programming paradigm: referential transparency, evaluation. The elements of the programming languages Clean and Haskell: simple function definitions, local definitions, higher order functions, patterns, guards, modules. Simple data structures, lists, tuples, ZF expressions, filters. Polymorph types, algebraic types.

Literature:

Thompson, S.: Haskell, The Craft of Functional Programming. Addison-Wesley, 1999.

Recommended literature:

Peyton Jones, J., Hughes J., et al.: Report on the Programming Language Haskell 98, A Non-strict, Purely Functional Language, February 1999.

Name of the course: Script languages

Course code: IP-08cSCNYE

Faculty member responsible for the course: Porkoláb Zoltán

Total credits: 3

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit	3		
Hours per week	2		
Type of testing	combined		

Topics:

Basic properties of script languages (interpretation, dynamic type system, automatic memory management, weak types, rapid application development, easier modification, heterogenous data structures). Main areas of application (quick solutions for small tasks, prototyping, web applications, system administration, larger projects). Data structures in script languages (textual types, numerical types, lists, hashes – dictionary, associative array). Introduction to regular expression. Programming practice in Python and Perl languages.

Literature:

Wall, L., Christiansen, T., Schwartz R. L.: Programming Perl (O'Reilly, 1998)
Lutz, M.: Programming Python (O'Reilly, 2001)

Recommended literature:

Perl Documentation: http://perldoc.perl.org/
Python Documentation: http://www.python.org/doc/
Wall, L., Christiansen, T., Schwartz R. L.: Learning Perl (O'Reilly, 1997)
Thomas, D., Hunt, A.: Programming Ruby (Addison-Wesley, 2000)

Name of the course: Web applications

Course code: IP-08bWAFEG

Faculty member responsible for the course: Illés Zoltán

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week	1	1	
Type of testing		practice	

Topics:
Web applications on platform .NET/C#. The HTML. The ASP.NET HTTP tapping pipeline. The page rendering model. Web controls. Web parts, consistent look and feel, personalization. Logging in, data binding, session state, caching. Web services.

Literature:
George Shepherd: ASP.NET 3.5 Step by Step (Microsoft Press 2008)
George Shepherd: ASP.NET 2.0 lépésről lépésre (Szak Kiadó 2006)
MSDN Library for Visual Studio .NET 2005 Microsoft Corporation, 2005
MSDN Online: http://msdn.microsoft.com
www.msdn.com

Recommended literature:
Illés Zoltán: Programozás C# nyelven (JOS, 2004)
Jason Price: C# adatbázisprogramozás (Kiskapu, 2004)

Name of the course: Web-design 1

Course code: IP-08tWF1EG

Faculty member responsible for the course: Illés Zoltán

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	1	2	1
Type of testing	combined		

Topics:
Basics of web-based applications, methodology of webpage design. Birth of the hypertext and the web, static webpage-designing tools, the necessity of separating appearance and content, XHTML 1.0 specification, typical errors in homepage editing and their elimination, methodology of webpage design, ergonomic issues and rules of design. Tools of web-based development: server- and client-side programming.

Literature:
Julie C. Meloni: Web világ: A Php, a MySql és az Apache használata (Panem)
Jakob Nielsen: Web-design (Typotex Elektronikus Kiadó, 2002 (második kiadás))
Sikos László: Stíluslapok a weben (BBS-Info Kft., 2005)
Sikos László: XHTML- a HTML megújulása XML alapokon (BBS-Info Kft., 2005)
Virginia DeBolt: HTML és CSS – webszerkesztés stílusosan 8Kiskapu Kft., 2005)

Recommended literature:

Name of the course: Web-design 2

Course code: IP-08tWF2EG

Faculty member responsible for the course: Illés Zoltán

Total credits: 4

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	1	2	1
Type of testing	combined		

Topics:
Basics of web-based applications, methodology of webpage design. Birth of the hypertext and the web, static webpage-designing tools, the necessity of separating appearance and content, XHTML 1.0 specification, typical errors in homepage editing and their elimination, methodology of webpage design, ergonomic issues and rules of design. Tools of web-based development: server- and client-side programming.

Literature:
Julie C. Meloni: Web világ: A Php, a MySql és az Apache használata (Panem)
Jakob Nielsen: Web-design (Typotex Elektronikus Kiadó, 2002 (második kiadás))
Sikos László: Stíluslapok a weben (BBS-Info Kft., 2005)
Sikos László: XHTML- a HTML megújulása XML alapokon (BBS-Info Kft., 2005)
Virginia DeBolt: HTML és CSS – webszerkesztés stílusosan (Kiskapu Kft., 2005)

Recommended literature:

Name of the course: Competition tasks in informatics 1

Course code: IP-08tINFV1G

Faculty member responsible for the course: Zsakó László

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week		2	
Type of testing		practice	

Topics:

This course deals with solving informatics contest problems. On the one hand, it reviews contests organized for secondary school students (Nemes Tihamér National Informatics Contest, the National Informatics Contest (OKTV), Central European Olympiad in Informatics, International Olympiad in Informatics). It prepares university students for national and international informatics contests (ACM International Collegiate Programming Contest, National 24 –hour Programming Team Contest, Imagine Cup), and manages their participation in them. The best students can take part in the national informatics contests.

Literature:

D. Marx – B. Benedek: International 24-hour Programming Contest Problem Sets (BME, 2005)
Zsakó László: Programozási versenyfeladatok tára I-III. (NJSZT, 2004-2006)

Recommended literature:

T.H.Cormen-C.E. Leiserson-R.L. Rivest: Algoritmusok (Műszaki Könyvkiadó, 2003)
Ivanyos G.-Rónyai L.-Szabó R.: Algoritmusok (TypoTex, 2003)

Name of the course: Competition tasks in informatics 2

Course code: IP-08tINFV2G

Faculty member responsible for the course: Zsakó László

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit		2	
Hours per week		2	
Type of testing		practice	

Topics:

This course deals with solving informatics contest problems. On the one hand, it reviews contests organized for secondary school students (Nemes Tihamér National Informatics Contest, the National Informatics Contest (OKTV), Central European Olympiad in Informatics, International Olympiad in Informatics). It prepares university students for national and international informatics contests (ACM International Collegiate Programming Contest, National 24 –hour Programming Team Contest, Imagine Cup), and manages their participation in them. The best students can take part in the national informatics contests.

Literature:

D. Marx – B. Benedek: International 24-hour Programming Contest Problem Sets (BME, 2005)
Zsakó László: Programozási versenyfeladatok tára I-III. (NJSZT, 2004-2006)

Recommended literature:

T.H.Cormen-C.E. Leiserson-R.L. Rivest: Algoritmusok (Műszaki Könyvkiadó, 2003)
Ivanyos G.-Rónyai L.-Szabó R.: Algoritmusok (TypoTex, 2003)

Name of the course: Principles of economics

Course code: IP-08KGAE/1

Faculty member responsible for the course: Kurtán Lajos

Total credits: 3

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3		
Hours per week	3		
Type of testing	exam		

Topics:

Subject and method of economics. Supply and demand curve, the Marshall-cross. How markets work. Shifts in the demand/supply curve. Elasticity of demand and supply and its application.
The consumption decisions. Description of preferences, representing preferences with indifference curves. Properties of indifference curves. Budget constraints, consumers' optimum choice. Income and price changes, determinants of individual demand-curve and Engel-curve, income and substitution effects.
The firm decisions: Production function and its properties. Concept of short and long runs. Short-run production function: Dynamics and relationship of marginal and average returns to a variable factor. Long-run production function and its characteristics. Concept and types of returns to scale, increasing, constant and decreasing returns. Isoquants maps and isocost, optimal choice.
Cost functions and their derivation: Deriving long-run and short-run cost functions for production functions. Short-run and long-run cost functions.
Market structures classification: Perfect competition as a type of market structure, monopoly as a market structure, monopolistic competition, oligopoly as a market structure.
Macroeconomics: Subject of macroeconomics, basic macroeconomics sectors and macroeconomics circular flow. Macroeconomics aggregates. Aggregate expenditures and equilibrium income.
Goods market and IS curve derivation. The monetary base and the money supply. The Supply of money: The money multiplier model. The Demand for money, money market and LM curve derivation. Equilibrium in IS-LM model. Effectiveness of fiscal and monetary policies.
The aggregate demand curve. The aggregate supply (AS) curve. Equilibrium in aggregate supply- aggregate demand model. Fiscal and monetary policies in the complete model.
Inflation and unemployment.

Literature:

Hóka Sándorné-Gelegonya Judit: Közgazdaságtan alapjai, Műegyetemi kiadó 2002.

Recommended literature:

Name of the course: Informatics for education

Course code: IP-08tKIEG

Faculty member responsible for the course: Zsakó László

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing		practice	

Topics:
Reviewing and summarizing informatics taught in secondary education, and studying its background. Reviewing the theoretical basis of informatics taught in secondary education, and its implementation in practice. Studying the elements of modern learning technologies and their practical application. Theory and practice of informatics problem-solving – applying Pólya's method.

Literature:
Szlávi Péter - Zsakó László: Módszeres programozás: Programozási bevezető
Hack Frigyes: Számítógéppel támogatott problémamegoldás
Szlávi Péter - Temesvári Tibor - Zsakó László: A programkészítés technológiája

Recommended literature:
Hack Frigyes: Informatikai ismeretek
Pólya György. A gondolkodás iskolája.
Pólya György: A problémamegoldás iskolája I.-II.

Name of the course: Basic Legal and Business Knowledge

Course code: IP-08JMIE/1

Faculty member responsible for the course: Kurtán Lajos

Total credits: 2

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit	2		
Hours per week	2		
Type of testing	combined		

Topics:

1. Starting a Business
2. The Types of Enterprises
3. Foundation, Operation and Bankruptcy of Enterprise
4. Business low
5. The Strategic Planning process
6. Business Planning
7. The Marketing Concept and the Marketing-mix
8. Management of Fixed Assets
9. Management of Current Assets
10. Human Recourses Management
11. Innovation
12. Information and Communication System
13. Finance
14. Characteristics of non-profit organization

Literature:

Thomas W. Malone, Kevin Crowston and George A. Herman: Organizing Business Knowledge

Recommended literature:

Bőgel György, F. Ható Katalin; Keresztes József; Salamonné Huszti Anna; Zárda Sarolta: Szervezési és vezetési ismeretek elmélet és gyakorlat informatikusoknak, Számalk, 2002. Bp. (Szerkesztette: Bőgel György)

Kurtán Lajos: Vállalkozás(élet)tan, ELTE Eötvös Kiadó, Bp, 2006. 33-39. oldal, 86-95. oldal, 261-285.oldal

Name of the course: Mathematical Statistics

Course code: IP-08aMSE

Faculty member responsible for the course: Móri Tamás

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	1	2	1
Type of testing		practice	

Topics:

Statistical space, samples, statistics. Ordered statistics, empirical distribution functions. Unbiased, efficient and consistent estimators. Complete and sufficient statistics. Neyman factorization theorem. Fisher information, Cramer-Rao inequality. Rao-Blackwell-Kolmogorov theorem. Confidence intervals. Maximum likelihood estimators, properties. The method of moments. Hypothesis testing. Comparison of tests. Randomized and sequential tests. The Neyman-Pearson lemma. U-, Student t-, and F-tests, C2-test, and its applications. Linear regression and the method of least squares. The simplest cases of variance analysis.

Literature:

John Wiley & Sons: An Introduction to Probability Theory and Mathematical Statistics (Paperback, March 1976)

Recommended literature:

Mogyoródi, Michaletzky (Szerk.): Matematikai statisztika (Egyetemi jegyzet, Nemzeti Tankönyvkiadó, Budapest, 1995)

Móri, Szeidl, Zempléni: Matematikai statisztika példatár (ELTE Eötvös Kiadó, 1997)

Name of the course: Probability theory

Course code: IP-08aVSZE, IP-08aVSZG

Faculty member responsible for the course: Móri Tamás

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

The notion of probability, elementary properties. Kolmogorov probability field. Combinatorial calculation of probabilities. Conditional probability, properties, calculation. Bayes' theorem. Independency. Random (vector)variable and its distribution, joint distributions. Independent random variables. Random walk and ruin probabilities. Particular discrete distributions. Mean and variance, properties, calculation, inequalities. Median, moments. Covariance and the coefficient of correlation. Distribution and density functions. The distribution of sums of independent random variables (convolution). Particular absolute continuous distributions and their properties. Weak law of large numbers. Central limit theorem. Normal and multivariate normal distribution.

Literature:

John Wiley & Sons: An Introduction to Probability Theory and Mathematical Statistics (Paperback, March 1976)

Recommended literature:

Baróti-Bognárné-Fejes Tóth-Mogyoródi: Valószínűségszámítás (ELTE TTK jegyzet, 1978)
W. Feller: Bevezetés a valószínűségszámításba és alkalmazásaiba (Műszaki Könyvkiadó, 1978)
Bognár Jánosné et al: Valószínűségszámítási feladatgyűjtemény (Typotex kiadó, 2001)
Mogyoródi – Michaletzky (Szerk.): Matematikai statisztika (Egyetemi jegyzet. Nemzeti Tankönyvkiadó, Budapest, 1995)
Móri – Szeidl – Zempléni: Matematikai statisztika példatár (ELTE Eötvös Kiadó, 1997)

Name of the course: Probability theory and Mathematical statistics

Course code: IP-08eVSZE, IP-08eVSZG

Faculty member responsible for the course: Móri Tamás

Total credits: 6

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	1	3
Type of testing	exam	practice	

Topics:

The notion of probability, elementary properties. Kolmogorov probability field. Combinatorial calculation of probabilities. Conditional probability, properties, calculation. Bayes' theorem. Independency. Random (vector)variable and its distribution, joint distributions. Independent random variables. Random walk and ruin probabilities. Particular discrete distributions. Mean and variance, properties, calculation, inequalities. Median, moments. Covariance and the coefficient of correlation. Distribution and density functions. The distribution of sums of independent random variables (convolution). Particular absolute continuous distributions and their properties. Weak law of large numbers. Central limit theorem. Normal and multivariate normal distribution.

Statistical space, samples, statistics. Ordered statistics, empirical distribution functions. Unbiased, efficient and consistent estimators. Complete and sufficient statistics. Neyman factorization theorem. Fisher information, Cramer-Rao inequality. Rao-Blackwell-Kolmogorov theorem. Confidence intervals. Maximum likelihood estimators, properties. The method of moments. Hypothesis testing. Comparison of tests. Randomized and sequential tests. The Neyman-Pearson lemma. U-, Student t-, and F-tests, C2-test, and its applications. Linear regression and the method of least squares. The simplest cases of variance analysis.

Literature:

John Wiley & Sons: An Introduction to Probability Theory and Mathematical Statistics (Paperback, March 1976)

Recommended literature:

Baróti-Bognárné-Fejes Tóth-Mogyoródi: Valószínűségszámítás (ELTE TTK jegyzet, 1978)
W. Feller: Bevezetés a valószínűségszámításba és alkalmazásaiba (Műszaki Könyvkiadó, 1978)
Bognár Jánosné et al: Valószínűségszámítási feladatgyűjtemény (Typotex kiadó, 2001)
Mogyoródi – Michaletzky (Szerk.): Matematikai statisztika (Egyetemi jegyzet. Nemzeti Tankönyvkiadó, Budapest, 1995)
Móri – Szeidl – Zempléni: Matematikai statisztika példatár (ELTE Eötvös Kiadó, 1997)

Name of the course: Probability theory and Mathematical statistics

Course code: IP-08bVSZE, IP-08bVSZG, IP-08cVSZE, IP-08cVSZG

Faculty member responsible for the course: Móri Tamás

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

The notion of probability, elementary properties. Kolmogorov probability field. Combinatorial calculation of probabilities. Conditional probability, properties, calculation. Bayes' theorem. Independency. Random (vector)variable and its distribution, joint distributions. Independent random variables. Random walk and ruin probabilities. Particular discrete distributions. Mean and variance, properties, calculation, inequalities. Median, moments. Covariance and the coefficient of correlation. Distribution and density functions. The distribution of sums of independent random variables (convolution). Particular absolute continuous distributions and their properties. Weak law of large numbers. Central limit theorem. Normal and multivariate normal distribution.

Statistical space, samples, statistics. Ordered statistics, empirical distribution functions. Unbiased, efficient and consistent estimators. Complete and sufficient statistics. Neyman factorization theorem. Fisher information, Cramer-Rao inequality. Rao-Blackwell-Kolmogorov theorem. Confidence intervals. Maximum likelihood estimators, properties. The method of moments. Hypothesis testing. Comparison of tests. Randomized and sequential tests. The Neyman-Pearson lemma. U-, Student t-, and F-tests, C2-test, and its applications. Linear regression and the method of least squares. The simplest cases of variance analysis.

Literature:

John Wiley & Sons: An Introduction to Probability Theory and Mathematical Statistics (Paperback, March 1976)

Recommended literature:

Baróti-Bognárné-Fejes Tóth-Mogyoródi: Valószínűségszámítás (ELTE TTK jegyzet, 1978)
W. Feller: Bevezetés a valószínűségszámításba és alkalmazásaiba (Műszaki Könyvkiadó, 1978)
Bognár Jánosné et al: Valószínűségszámítási feladatgyűjtemény (Typotex kiadó, 2001)
Mogyoródi – Michaletzky (Szerk.): Matematikai statisztika (Egyetemi jegyzet. Nemzeti Tankönyvkiadó, Budapest, 1995)
Móri – Szeidl – Zempléni: Matematikai statisztika példatár (ELTE Eötvös Kiadó, 1997)

Name of the course: Linear Algebra

Course code: IP-08eLAE, IP-08eLAG

Faculty member responsible for the course: Szalay Mihály

Total credits: 6

Total hours: 3

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	1	3
Type of testing	exam	practice	

Topics:

Introduction to Systems of Linear Equations, Gaussian Elimination, Homogeneous Systems, Matrices and Matrix Operations, Rules of Matrix Arithmetic, Different Methods of Finding the Inverse, Determinant, Properties of Determinant Function, Cofactor Expansion, Cramer's Rule, Vectors in 2D and 3D, Norm, Dot Product, Projection, Cross Product, Lines and Planes, Vector Spaces, Subspaces, Linear Independence.

Basis, Dimension, Orthonormal Basis, Gram-Schmidt Process, Change of Basis, Linear Transformations, Kernel, Range, Matrices of Linear Transformations, Similarity, Eigenvalues, Eigenvectors, Diagonalization of Matrices, Symmetric Matrices.

Literature:

Gilbert Strang: Introduction to Linear Algebra (Wellesley-Cambridge Press, June 1998)

Recommended literature:

Gyapjas Ferenc: Lineáris algebra és geometria (egyetemi jegyzet, 1976)

Freud Róbert: Lineáris Algebra, 1996.

Rózsa Pál: Lineáris algebra és alkalmazásai, 1976.

Name of the course: Linear Algebra

Course code: IP-08LAE, IP-08LAG

Faculty member responsible for the course: Szalay Mihály

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

Introduction to Systems of Linear Equations, Gaussian Elimination, Homogeneous Systems, Matrices and Matrix Operations, Rules of Matrix Arithmetic, Different Methods of Finding the Inverse, Determinant, Properties of Determinant Function, Cofactor Expansion, Cramer's Rule, Vectors in 2D and 3D, Norm, Dot Product, Projection, Cross Product, Lines and Planes, Vector Spaces, Subspaces, Linear Independence.

Basis, Dimension, Orthonormal Basis, Gram-Schmidt Process, Change of Basis, Linear Transformations, Kernel, Range, Matrices of Linear Transformations, Similarity, Eigenvalues, Eigenvectors, Diagonalization of Matrices, Symmetric Matrices.

Literature:

Gilbert Strang: Introduction to Linear Algebra (Wellesley-Cambridge Press, June 1998)

Recommended literature:

Gyapjas Ferenc: Lineáris algebra és geometria (egyetemi jegyzet, 1976)

Freud Róbert: Lineáris Algebra, 1996.

Rózsa Pál: Lineáris algebra és alkalmazásai, 1976.

Name of the course: Data Bases 1

Course code: IP-08aAB1E, IP-08aAB1G, IP-08bAB1E, IP-08bAB1G, IP-08cAB1E, IP-08cAB1G, IP-08tAB1E, IP-08tAB1G

Faculty member responsible for the course: Benczúr András

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

The concept of data bases. Physical and logical data independence. The data base administrator. Basic characteristics of data base handling languages. Classical data processing modes and the comparison of data base handling systems. The levels of data modelling. Tendencies in data modelling. The hierarchical, the netted, the relational data models.

Literature:

Ullman J.D., Widom J. : Database Systems Implementation (Prentice Hall, United States edition, June 11, 1999)

Recommended literature:

Békéssy A., Demetrovics J. : Adatbázis-szerkezetek (Akadémiai Kiadó, Budapest, 2005)
Kende M., Kotsis D., Nagy I. :Adatbázis-kezelés az ORACLE rendszerben (Panem Kft., Budapest, 2002)
Gábor A., Juhász I.: PL/SQL-programozás (Panem, Budapest, 2007)
Kende M., Nagy I.: Oracle-példatár (SQL, PL/SQL) (Panem, Budapest, 2005)
Loney K.: Oracle database 10g Teljes referencia (Panem, Budapest, 2006)

Name of the course: Data Bases 1

Course code: IP-08eAB1E, IP-08eAB1G

Faculty member responsible for the course: Benczúr András

Total credits: 6

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	3	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

The concept of data bases. Physical and logical data independence. The data base administrator. Basic characteristics of data base handling languages. Classical data processing modes and the comparison of data base handling systems. The levels of data modelling. Tendencies in data modelling. The hierarchical, the netted, the relational data models.

Literature:

Ullman J.D., Widom J. : Database Systems Implementation (Prentice Hall, United States edition, June 11, 1999)

Recommended literature:

Békéssy A., Demetrovics J. : Adatbázis-szerkezetek (Akadémiai Kiadó, Budapest, 2005)
Kende M., Kotsis D., Nagy I. :Adatbázis-kezelés az ORACLE rendszerben (Panem Kft., Budapest, 2002)
Gábor A., Juhász I.: PL/SQL-programozás (Panem, Budapest, 2007)
Kende M., Nagy I.: Oracle-példatár (SQL, PL/SQL) (Panem, Budapest, 2005)
Loney K.: Oracle database 10g Teljes referencia (Panem, Budapest, 2006)

Name of the course: Data Bases 2

Course code: IP-08aAB2E, IP-08aAB2G, IP-08bAB2E, IP-08bAB2G, IP-08tAB2E, IP-08tAB2G

Faculty member responsible for the course: Benczúr András

Total credits: 4

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	2	2	
Hours per week	2	2	
Type of testing	exam	practice	

Topics:

Relational data models. Concept of the domain, the attribute, the record. Relation as a concept of Descartes series, as mapping, as a table. The key and is characteristics. The functional dependence and its properties, families. Decomposition and it's properties. The four normal forms. Normalisation. The operations of relational algebra.
Application of the dBase III language in data base handling.
XML, DTD, XML Schema, XPath, XQuery, XSLT.

Literature:

Ullman J.D., Widom J. : Database Systems Implementation (Prentice Hall, United States edition, June 11, 1999)

Recommended literature:

Békéssy A., Demetrovics J. : Adatbázis-szerkezetek (Akadémiai Kiadó, Budapest, 2005)
Kende M., Kotsis D., Nagy I. :Adatbázis-kezelés az ORACLE rendszerben (Panem Kft., Budapest, 2002)
Gábor A., Juhász I.: PL/SQL-programozás (Panem, Budapest, 2007)
Kende M., Nagy I.: Oracle-példatár (SQL, PL/SQL) (Panem, Budapest, 2005)
Loney K.: Oracle database 10g Teljes referencia (Panem, Budapest, 2006)

Name of the course: Data Bases 2

Course code: IP-08cAB2E, IP-08cAB2G

Faculty member responsible for the course: Benczúr András

Total credits: 5

Total hours: 4

Type of the course	Lecture	Practice	Consultation
Credit	3	2	
Hours per week	2	2	1
Type of testing	exam	practice	

Topics:

Relational data models. Concept of the domain, the attribute, the record. Relation as a concept of Descartes series, as mapping, as a table. The key and is characteristics. The functional dependence and its properties, families. Decomposition and it's properties. The four normal forms. Normalisation. The operations of relational algebra.
Application of the dBase III language in data base handling.
XML, DTD, XML Schema, XPath, XQuery, XSLT.

Literature:

Ullman J.D., Widom J. : Database Systems Implementation (Prentice Hall, United States edition, June 11, 1999)

Recommended literature:

Békéssy A., Demetrovics J. : Adatbázis-szerkezetek (Akadémiai Kiadó, Budapest, 2005)
Kende M., Kotsis D., Nagy I. :Adatbázis-kezelés az ORACLE rendszerben (Panem Kft., Budapest, 2002)
Gábor A., Juhász I.: PL/SQL-programozás (Panem, Budapest, 2007)
Kende M., Nagy I.: Oracle-példatár (SQL, PL/SQL) (Panem, Budapest, 2005)
Loney K.: Oracle database 10g Teljes referencia (Panem, Budapest, 2006)

Name of the course: Data Bases 2

Course code: IP-08eAB2E

Faculty member responsible for the course: Benczúr András

Total credits: 3

Total hours: 2

Type of the course	Lecture	Practice	Consultation
Credit	3		
Hours per week	2		
Type of testing	exam		

Topics:

Relational data models. Concept of the domain, the attribute, the record. Relation as a concept of Descartes series, as mapping, as a table. The key and is characteristics. The functional dependence and its properties, families. Decomposition and it's properties. The four normal forms. Normalisation. The operations of relational algebra.
Application of the dBase III language in data base handling.
XML, DTD, XML Schema, XPath, XQuery, XSLT.

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Ullman J.D., Widom J. : Database Systems Implementation (Prentice Hall, United States edition, June 11, 1999)

Recommended literature:

Békéssy A., Demetrovics J. : Adatbázis-szerkezetek (Akadémiai Kiadó, Budapest, 2005)
Kende M., Kotsis D., Nagy I. :Adatbázis-kezelés az ORACLE rendszerben (Panem Kft., Budapest, 2002)
Gábor A., Juhász I.: PL/SQL-programozás (Panem, Budapest, 2007)
Kende M., Nagy I.: Oracle-példatár (SQL, PL/SQL) (Panem, Budapest, 2005)
Loney K.: Oracle database 10g Teljes referencia (Panem, Budapest, 2006)