Faculty of Natural Sciences

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMETE11AF11	Applied Solid State Physics	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	T0	English	

Band structure of metals and semiconductors, electron transport, electron scattering mechanisms, 2 dimensional electron gases, Si technology (FET, SSD memory), semiconductor heterostructure (semiconductor laser, MEMT), nanoelectronics, single electron transistor. – Magnetic materials, origin of magnetic momentum and interaction between moments, magnetic structures. Magnetism of metals, spin polarized bands, spintronics devices (spin valve, MRAM). Spin transistor, magnetic semiconductors.– Jenő Sólyom: Fundamentals of the Physics of Solids (Springer 2007) – Thomas Ihn: Semiconductor Nanostructures: Quantum States and Electronic (2009)

Subject code	Subject name	Requirement	ECTS credit
BMETE11AX14	Nobel Prize Physics in Everyday Application	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	T0	English	TUE:14:15-16:00;

Scope: The amazing and explosive development of technology is our everyday experience in various fields of life from informatics and medicine. It is less well known how this development is supported by scientific research. As an example a notebook computer applies numerous Nobel Prize awarded ideas, like the integrated circuits (2000), semiconducting laser (2000), liquid crystal display (1991), CCD camera (2009), GMR sensor of the hard disk (2007) and several further achievements from earlier days of quantum mechanics and solid state physics. The course is intended to give insight to a range of amazing everyday applications that are related to various Nobel Prizes with a special focus on recent achievements. The topics below are reviewed at a simplified level building on high school knowledge of physics. Syllabus:- Textbook applications from the early days of Nobel prizes: wireless broadcasting, X -rays, radioactivity, etc.- Optics in everyday application: lasers, CCD cameras, optical fibers, liquid crystal displays, holography- Quantum physics: from atom models to quantum communication- Measurements with utmost precision: application of Einstein's theory of relativity in GPS systems, atomic clocks, Michelson interferometry, etc.- Nuclear technology from power plants to medical and archeological applications- Advanced physics in medicine: magnetic resonance imaging, computer tomography and positron emission tomography- Semiconductors from the first transistor to mobile communication- Fundamental tools of nanotechnology (scanning probe microscopes, electron beam lithography, etc)- Spintronics from the discovery of electron spin to everyday application in data storage devices- Exotic states of solids in everyday application: superconducting magnets and levitated trains- Towards quot;all carbon electronicsquot;: envisioned and already realized applications of graphene

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF04	Seminar RP2	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	T1	English	FRI:12:15-14:00;

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF06	Seminar RP4	Signature	0

Course type	Course code	Course language	Timetable information
Practice	T1	English	FRI:12:15-14:00;

Subject code	Subject name	Requirement	ECTS credit
BMETE11MF12	Group Theory in Solid State Research	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	T0	English	THU:14:15-16:00;

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF25	Seminar on Nanophysics 1		Mid-semester mark	2
Course type	**Course code**	**Course language**	**Timetable information**	
Practice	T1	English		

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF31	Seminar on Optical Spectroscopy 2		Mid-semester mark	2
Course type	**Course code**	**Course language**	**Timetable information**	
Practice	T1	English		

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF37	Fundamentals of Nanophysics		Exam	4
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	T0	English	WED:09:15-12:00(F3213);	

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF39	Optical Spectroscopy in Materials Science		Exam	4
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	T0	English		

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF40	Trends in Nanotechnology		Mid-semester mark	2
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	T0	English		

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF43	Magnetic Resonance		Exam	4
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	T0	English		
Practice	T1	English		

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF44	Theory of Magnetism		Exam	4
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	T0	English		
Practice	T1	English		

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF48	Seminar NA2		Mid-semester mark	2
Course type	**Course code**	**Course language**	**Timetable information**	
Practice	T1	English		

Subject code	Subject name		Requirement	ECTS credit
BMETE11MF50	Seminar NA4		Signature	0
Course type	**Course code**	**Course language**	**Timetable information**	
Practice	T1	English		

Subject code	Subject name	Requirement	ECTS credit
BMETE11MX22	Physics Laboratory for Civil Engineers	Mid-semester mark	1

Course type	Course code	Course language	Timetable information
Laboratory	EA1	English	TUE:14:15-18:00(F32L1); TUE:14:15-18:00(F32L1);

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX02	Mathematics A2a - Vector Functions	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-GPK	English	MON:16:15-19:00; TUE:16:15-17:00;
Lecture	EN0-EMK	English	MON:16:15-18:00(K389); MON:16:15-18:00(K389); TUE:08:15-10:00(KF88); TUE:08:15-10:00(KF88);
Practice	EN1-EMK	English	WED:16:15-18:00(K374); WED:16:15-18:00(K374);
Practice	EN2-EMK	English	
Practice	EN1-GPK	English	TUE:17:15-19:00;

Solving systems of linear equations: elementary row operations, Gauss-Jordan- and Gaussian elimination. Homogeneous systems of linear equations. Arithmetic and rank of matrices. Determinant: geometric interpretation, expansion of determinants. Cramer's rule, interpolation, Vandermonde determinant. Linear space, subspace, generating system, basis, orthogonal and orthonormal basis. Linear maps, linear transformations and their matrices. Kernel, image, dimension theorem. Linear transformations and systems of linear equations. Eigenvalues, eigenvectors, similarity, diagonalizability. Infinite series: convergence, divergence, absolute convergence. Sewuences and series of functions, convergence criteria, power series, Taylor series. Fourier series: axpansion, odd and even functions. Functions in several variables: continuity, differential and integral calculus, partial derivatives, Young's theorem. Local and global maxima / minima. Vector-vector functions, their derivatives, Jacobi matrix. Integrals: area and volume integrals.

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX17	Mathematics A2c	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-CA0	English	TUE:16:15-19:00(CH308); WED:16:15-19:00(CH308);
Practice	EN0-CA1	English	TUE:16:15-19:00(CH308); WED:16:15-19:00(CH308);

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX22	Calculus 2 for Informaticians	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-EB0	English	TUE:10:15-12:00; WED:10:15-12:00;
Practice	EN1-EB1	English	THU:12:15-14:00;

Differential equations: Separable d.e., first order linear d.e., higher order linear d.e. of constant coefficients. Series: Tests for convergence of numerical series, power series, Taylor series. Functions of several variables: Limits, continuity. Differentiability, directional derivatives, chain rule. Higher partial derivatives and higher differentials. Extreme value problems. Calculation of double and triple integrals. Transformations of integrals, Jacobi matrix. Analysis of complex functions: Continuity, regularity, Cauchy - Riemann partial differential equations. Elementary functions of complex variable, computation of their values. Complex contour integral. Cauchy - Goursat basic theorem of integrals and its consequences. Integral representation of regular functions and their higher derivatives (Cauchy integral formulae).

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX26	Mathematics A2f - Vector Functions	Mid-semester mark	6

Course type	Course code	Course language	Timetable information
Lecture	EN0-VIK	English	MON:10:15-12:00; WED:08:15-10:00;
Practice	EN1-VIK	English	FRI:12:15-14:00;

Solving systems of linear equations: elementary row operations, Gauss-Jordan- and Gaussian elimination. Homogeneous systems of linear equations. Arithmetic and rank of matrices. Determinant: geometric interpretation, expansion of determinants. Cramer's rule, interpolation, Vandermonde determinant. Linear space, subspace, generating system, basis, orthogonal and orthonormal basis. Linear maps, linear transformations and their matrices. Kernel, image, dimension theorem. Linear transformations and systems of linear equations. Eigenvalues, eigenvectors, similarity, diagonalizability. Infinite series: convergence, divergence, absolute convergence. Sewuences and series of functions, convergence criteria, power series, Taylor series. Fourier series: axpansion, odd and even functions. Functions in several variables: continuity, differential and integral calculus, partial derivatives, Young's theorem. Local and global maxima / minima. Vector-vector functions, their derivatives, Jacobi matrix.

Integrals: area and volume integrals.

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX34	Mathematics EP2	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Practice	EN1	English	WED:08:15-10:00(K393);

Limit, continuity, partial derivatives and differentiability of functions of multiple variables. Equation of the tangent plane. Local extrema of functions of two variables. Gradient and directional derivative. Divergence, rotation. Double and triple integrals and their applications. Polar coordinates. Substitution theorem for double integrals. Curves in the 3D space, tangent line, arc length. Line integral. 3D surfaces. Separable differential equations, first order linear differential equations. Algebraic form of complex numbers. Second order linear differential equations with constant coefficients. Taylor polynomial of exp(x), sin(x), cos(x). Eigenvalues and eigenvectors of matrices.

Subject code	Subject name	Requirement	ECTS credit
BMETE90AX51	Mathematics A4 - Probability Theory	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	EN0-A0	English	
Practice	EN1-A1	English	

Notion of probability. Conditional probability. Independence of events. Discrete random variables and their distributions (discrete uniform distribution, classical problems, combinatorial methods, indicator distribution, binomial distribution, sampling with/without replacement, hypergeometrical distribution, Poisson distribution as limit of binomial distributions, geometric distribution as model of a discrete memoryless waiting time). Continuous random variables and their distributions (uniform distribution on an interval, exponential distribution as model of a continuous memoryless waiting time, standard normal distribution). Parameters of distributions (expected value, median, mode, moments, variance, standard deviation). Two-dimensional distributions. Conditional distributions, independent random variables. Covariance, correlation coefficient. Regression. Transformations of distributions. One- and two-dimensional normal distributions. Laws of large numbers, DeMoivre-Laplace limit theorem, central limit theorem. Some statistical notions. Computer simulation, applications.

Subject code	Subject name	Requirement	ECTS credit
BMETE90MX44	Mathematics M1c - Differential Equations	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	EN-CA0	English	WED:08:15-10:00(H207);
Practice	EN-CA1	English	THU:08:15-10:00(H207);

Preliminaries: one- and multivariate calculus, elements of linear algebra. Explicit first order ordinary differential equations and it solution. Simple types. Linear systems. Higher order equations. Laplace transform, properties and applications. Elements of the qualitative theory. On partial differential equations. Elements of variational calculus.

Subject code	Subject name	Requirement	ECTS credit
BMETE90MX54	Advanced Mathematics for Electrical Engineers - Linear Algebra	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	MON:08:15-10:00;
Practice	EN1	English	FRI:10:15-12:00;

System of linear of equations, Gaussian elimination, vectors, vector spaces, subspaces, basis, matrices, special matrices, LU and PLU decomposition of a matrix, determinants, linear transformations and its properties, computation of the eigenvalues and eigenvectors, euclidean space, orthogonality, diagonalization of a matrix, Jordan canonical form of a matrix, Jordan basis, orthogonal diagonalization, norm of vectors and matrices, singular value decomposition of a matrix, nonnegative matrices, matrix functions, Perron-Frobenius theory. J. Hefferon: Linear Algebra, 3rd ed.C.D. Meyer: Matrix Analysis and Applied Linear Algebra

Subject code	Subject name	Requirement	ECTS credit
BMETE92AX46	Evolutionary Computing	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	A1	English	FRI:09:15-10:00;
Lecture	A0	English	FRI:08:15-09:00;

Introduction: optimization problems, counterexample for brute-force type algorithms, the basic concept of genetic algorithms: biological ground (gene, inheritance, evolution, fitness). The general scheme of genetic algorithms, the realization in the most simple case. Representation in evolutionary algorithms, operators (crossover and mutation) for bit representation, roulette wheel and tournament selection, elitism. Traveling agent problem. Permutation representation and its operators (pmx, cyclic, edge, order, inversion, swap, insert, shuffle). Choosing suitable fitness function, its influence on selection pressure, the problem of constraint handling. Theory of simple genetic algorithms, theory of building block and its critic (Gray coding). Scheme theorem, No Free Lunch Theorem. Evolutionary

strategies: simulated annealing as progenitor, genetic version: Rechenberg's algorithm, crossover operators (the problem of correlation). Mutation operators, multidimensional normal distribution, (mu+lambda) vs (mu, lambda) selection. Parameter control: tuning - control - self adaptation. 1/5 rule, adaptation for discrete representation. Measuring the efficiency of genetic algorithms, MBF, SR, AES. Evolutionary programming: representation with finite state machines, realization of operators. Blondie24. Genetic programming: tree representation, crossover and mutation operators.

Subject code	Subject name	Requirement	ECTS credit
BMETE92AX50	Introduction to Programing Matlab for Engineers	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Laboratory	A0	English	FRI:10:15-12:00;

The goal of the course is to present a versatile and effective tool (for numeric and symbolic calculations, simulations, creating graphics and presentations), the Matlab software, which the students can also use later as researchers.Detailed course description: Introduction: Matlab as numerical calculator. Defining vectors, built-in vector operators. Matrix operations. Logical indexing of arrays. Defining custom functions, using the built-in debugger of the Matlab editor. Cycles and logical operators in Matlab, implementing simple algorithms. Symbolic calculations: calculating limits, derivatives, integrals. The consequences of using floating point arithmetic: inaccurate number representation, the propagation of error during calculations. Solving system of linear equations using Matlab, exploiting the properties of the coefficient matrix (triangular, symmetric hermitian, spare). Estimating the precision of the solution using the condition number. Solving under and over determined systems. Interpolation using polynomials, parameter fitting, log-log scale. Solving nonlinear equations. Importing data: file handling, importing and exporting text files, modifying and processing texts. Importing and handling Excel files, creating basic statistics. Graphics in Matlab: creating and exporting graphs, diagrams and histograms. Basic statistics in Matlab, applying statistical tests for independence and fitting. Problem of generating random numbers. Importing, storing and modifying pictures. Processing pictures: contour detection and counting objects. Usage of the publish function, creating presentations and documentation. Solving differential equations and stiff system of equations. The types of equilibra, stability testing.A. Ledeczky, M. Fitzpatrick: Computer Programming with MATLAB.Stoyan Gisbert: Matlab (frissített kiadás), Typotex 2005

Subject code	Subject name	Requirement	ECTS credit
BMETE94AM18	Geometry	Exam	6

Course type	Course code	Course language	Timetable information
Lecture	E0	English	

Subject code	Subject name	Requirement	ECTS credit
BMETE94AM19	Differential Geometry 1	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Lecture	EN0	English	
Practice	EN1	English	

Subject code	Subject name	Requirement	ECTS credit
BMETETOP201	Vibration, Waves and Thermodynamics	Exam	0

Course type	Course code	Course language	Timetable information
Lecture	E0	English	
Practice	C1	English	
Practice	B1	English	
Practice	A1	English	

Subject code	Subject name	Requirement	ECTS credit
BMETETOP202	Optics and Atomic Physics	Exam	0

Course type	Course code	Course language	Timetable information
Lecture	A0	English	
Practice	A1	English	
Practice	B1	English	
Practice	C1	English	

Subject code	Subject name		Requirement	ECTS credit
BMETETOPB22	Basic Mathematics 1		Mid-semester mark	0
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0-A0	English	WED:17:15-19:00(K376); WED:17:15-19:00(K376); THU:17:15-19:00(K376); THU:17:15-19:00(K376);	

Subject code	Subject name		Requirement	ECTS credit
BMETETOPB23	Basic Mathematics 2		Mid-semester mark	0
Course type	**Course code**	**Course language**	**Timetable information**	
Lecture	EN0-A0-1	English	TUE:15:15-18:00(K376); TUE:15:15-18:00(K376); FRI:13:15-15:00(K375); FRI:13:15-15:00(K375);	