REQUIREMENTS FOR GRADUATION

1) A student must take and pass all the courses listed above with a minimum GPA of 2.00 out of 4.00 to graduate from the Physics Department of IZTECH. Five elective courses must be techical and three elective courses must be non-technical.

2) A course with label **PRCD** can be taken if the indicated course is passed with a satisfactory grade (as a *Prerequisite* course).

3) A course with label **CRCD** can be taken together with the indicated course (as a *Corequisite* course).

4) The two courses PHYS 461 Research Study I and PHYS 462 Research Study II are for "Undergraduate Graduation Projects", and can be taken by the students having a 2,5 or more GPA. Taking these courses requires the *consent* of the *instructor*, and an instructor can have any number of students per semester. These courses are finalized with an *Oral Presentation* by the student and his/her submittal of a *Research Report* to the Instructor.

CONTENTS OF THE MANDATORY COURSES

PHYS 101 General Physics I (2+2)3 ECTS 6

Scientific notation, length, time, mass, unit systems, dimensional analysis. Motion along a straight line. Motion in two and three dimensions. Force and Motion. Newton's laws and their applications. Kinetic energy, work, power, and potential energy. Systems of particles. Linear momentum and collisions. Rotation, angular momentum and its conservation. Equilibrium and elasticity. Gravitation.

PHYS 102 General Physics II (2+2)3 ECTS 6

Electric charge: Coulomb's law, Electric field and field lines. Gauss' law. electric potential and electric potential energy. Capacitors and dielectrics. Currents in materials. Direct current circuits. The effects of magnetic fields. The production and properties of magnetic fields: Ampere's law, Gauss' law for magnetism, and the Bio-Savart law. Faraday's law of induction. Magnetism and matter.

PHYS 111 General Physics Laboratory I (0+2)1 ECTS 2

Experiments complementary to the course material related to the topics discussed in PHYS 101 General Physics I lectures will be carried out in this laboratory section. CRCD: PHYS 101.

PHYS 112 General Physics Laboratory II (0+2)1 ECTS 2

Experiments complementary to the course material related to the topics discussed in PHYS 102 General Physics II lectures will be carried out in this laboratory section. CRCD: PHYS 102.

MBG 101 Biology I (3+0)3 ECTS 5

Atoms and Molecules, biomolecules, structure of the cell, energy and life, metabolic reactions, photosynthesis, cell disassociation, evolution mechanisms, anatomy and physiology of animals.

PHYS 114 Introduction to Programming for Physicists (3+0)3 ECTS 4

A brief introduction to Unix operating system and commands. Introductory programming concepts, number systems, expressions, basic data structures, algorithmic processes; applications to numerical and non-numerical problems using Fortran. Solutions of physical problems will be emphasized.

MATH 145 Calculus for Engineering and Science I (4+2)5 ECTS 7

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

MATH 146 Calculus for Engineering and Science II (4+2)5 ECTS 8

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

CHEM 121 General Chemistry I (3+0)3 ECTS 5

Matter, its properties and measurement. Introduction to atomic theory, stoichiometry. The structural and chemical properties of matter. Gases, liquids and solids. Intermolecular forces. Atomic and molecular structure. Compounds, molecules and molecular formulas. Ions and ionic compounds. Atomic and electronic configurations and periodicity. Basic concepts of chemical bonding, ionic, covalent and metallic bonding.

CHEM 122 General Chemistry II (3+0)3 ECTS 5

Solutions and their behaviour; physical properties of solutions. Chemical kinetics, rates and mechanisms of chemical reactions. Chemical equilibrium and chemical thermodynamics, electrochemistry. The chemistry of acids and bases. Reactions between acids and bases.

Precipitation reactions. The chemistry of elements, metals, metalloids and nonmetals. The chemistry of hydrogen and the s-block elements**.**

CHEM 141 General Chemistry Laboratory I (0+2)1 ECTS 2

Experiments complementary to the course material related to the topics discussed in CHEM 121 General Chemistry I lectures will be carried out in this laboratory section.

CHEM 142 General Chemistry Laboratory II (0+2)1 ECTS 2

Experiments complementary to the course material related to the topics discussed in CHEM 122 General Chemistry II lectures will be carried out in this laboratory section.

ENG 101 Development of Reading and Writing Skills I (3+0)3 ECTS 3

This is a compulsory course for all freshmen students. It is a three-credit course with 3 ECTS credits offered in Fall Term. This course teaches skills and structures for reading, interpreting and creating academic writing. It involves a careful examination of a variety of reading texts with examples of discipline-specific structures needed while writing. Academic Errglish reading and writing skills will develop through research and composition. Authentic lectures, in-class activities and presentations will serve to improve listening and speaking proficiency.
At the end of the course, students will be able to
• Carry out research
• Recognize scientific writing
• Evaluate the reliability of sources
• Analyze data in written context
• Recognize the relationship between ideas in a text
• Paraphrase, quote and synthesize sources
• Cite sources
• Write a response to a written text
• Write a well-organized essay
• Express critical thoughts in oral and written context
• Prepare and deliver an effective presentation
• Avoid plagiarism

Throughout the semester, the students evaluate scientific articles, submit one essay and give an academic talk. At the end ofthe semester, they take a final exam.

ENG 102 Development of Readindg and Writing Skills II (3+0)3 ECTS 3

This is a compulsory course for all first year undergraduate students. It is a three-credit course with 3 ECTS credits offered in Spring Term. This curse teaches skills and structures for reading, interpreting and creating academic writing. It involve a careful examination of a variety of reading texts with examples of discipline-specific structures needed while writing. Academic English reading and writing skills will develop through research and composition. Authentic lectures, in-class activities and presentations will serve to improve listening and speaking proficiency.
At the end of the course, students will be able to
• Write an academic paper as response to a given article
• Express critical thoughts in oral and written context
• Read and understand research articles

• Prepare and deliver an effective presentation
• Use critical and creative thinking skills
• Analyze scientific or technical articles
• Find solutions to scientific or technical problems and present them

Throughout the semester, the students take notes on scientific articles, submit one paper and give an academic talk. At the end ofthe semester, they take a final exam.

PHYS 201 Waves and Optics (4+0)4 ECTS 6

Oscillations, simple harmonic motion, damped and forced harmonic motion, pendulums. Waves and particles, sound waves, travelling and standing waves, resonance. Interference of waves. Doppler Effect. Light and images, geometric optics, mirrors, lenses, and optical instruments. Light as a wave, interference, diffraction, and polarization.

PHYS 203 Classical Mechanics I (3+0)3 ECTS 7

Particle Dynamics, one particle dynamics, Newton's principles and vector mechanics. Energy methods and vector-energy mixed methods. Two Particle Dynamics and center of mass frames. Short Introduction to many particle dynamics. Rigid body dynamics, moment of Inertia tensor. Agular momentum of a rigid body. Kinetic energy of a rigid body.

PHYS 204 Classical Mechanics II (3+0)3 ECTS 7

Langrangian formulation, D'Alambert principle and Langrangian for a system. Hamiltonian, Legendre transformations. Hamilton's equations of motion. Canonical transformations. Vibrations and stability. PRCD: PHYS 203

PHYS 212 Waves and Optics Lab (0+4)2 ECTS 2

Experiments complementary to the course material related to the topics discussed in PHYS 201 Waves and Optics. PRCD: PHYS 201

PHYS 222 Modern Physics (4+0)4 ECTS 7

Special relativity, blackbody radiation, photoelectric and Compton effects. Bohr theory, quantum atom. Wave-particle duality. Schrodinger theory. Brief review of one-electron and multi-electron atoms.

PHYS 266 Mathematical Methods of Physics (4+0)4 ECTS 7

The parts of the essential mathematical background that is necessary in undergraduate physics education and that are not studied in the basic mathematics courses will be taught.. The following topic will be covered: Basic complex calculus, Fourier series, Dirac delta function, Fourier transform, partial differential equations of physics: separation of variable method, power series solutions of differential equations., Legendre polynomials; spherical harmonics. Bessel functions. Laguerre polynomials, Hermite polynomials, gamma and beta functions.

MATH 255 Differential Equations (4+0)4 ECTS 6

Classification of differential equations. Initial and boundary value problems. Exact and separable differential equations. Linear and Bernoulli equation .Higher order differential equations: Homogenous linear equations with constant coefficient. The method of undetermined coefficients, variation of parameters, the Cauchy Eulerequation. Series solutions of linear differential equations. Bessel differential equations. The Laplace transform.

MATH 265 Basic Linear Algebra (3+0)3 ECTS 4

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

TURK 201 Turkish Language I (2+0) Non-credit ECTS 2

Structure of Turkish language and its place among other world languages, Writing and speaking language, history of Turkish writing language. Turkish grammer structure in detail.

TURK 202 Turkish Language II (2+0) Non-credit ECTS 2

Written and oral expressions in Turkish language, structure of advanced writing in Turkish language, reading and understanding.

HIST 201 Principles of Kemal Atatürk I (2+0) Non-credit ECTS 2

Reform movements as a reaction to decline and disintegration of the Ottoman Empire caused by political, social, cultural and socio-psycological problems that emerged as a result of the encounter of the western and Turkish cultures; political events during the transitional period from the Ottoman Empire to the national struggle led by Mustafa Kemal Atatürk.

HIST 202 Principles of Kemal Atatürk II (2+0) Non-credit ECTS 2

Political , social, economic and cultural changes and developments caused by the restructuring of the state and society in line with the Atatürk's principals and revolutions which aimed at rising the Turkish Republic to the level of modern nations; Evaluation of the internal and external political events with the aim of finding solution to current problems.

PHYS 301 Electromagnetic Theory I (4+0)4 ECTS 8

Vector algebra, dıfferential and integral calculus, and curvilinear coordinates. Electrostatistics, Gauss' law, divergence and curl of electrostatic fields, electric potential and special techniques, Laplace equations and methods of imaging. Static electric fields in matter, polarization, electric displacement. and dielectric materials.

PHYS 302 Electromagnetic Theory II (4+0)4 ECTS 8

Magnetostatics, Lorentz force lar, Biot-Savart law, divergence and curl of magneic field, vector potential, magnetic fields in matter and magnetization. Electrodynamics, electromotive force and magnetic induction, Faraday's law, Maxwell's equations. Electromagnetic waves in vacuum and in matter, absorption and dispersion, guided waves. Potentials and fields, radiation, relativistic electrodynamics. PRCD: PHYS 301

PHYS 305 Experiments in Modern Physics (0+4)2 ECTS 8

Complete comprehension of modern physics. The experiments providing hints for quantum phenomenon: Millikan's oil drop experiment, e/m determination from Electric and Magnetic deviation, Electron diffraction, thermal radiation, photoelectric effect, Kerr effect, ESR experiment. PRCD: PHYS 222

PHYS 315 Numerical Methods in Physics (2+2)3 ECTS 6

Solving systems of linear equations, roots of polynomials, non-linear functions, determinants, eigenvalues and eigenfunctions, solving differential equations, applications of fast Fourier tranform.

PHYS 320 Introductory Electronic Circuits (2+2)3 ECTS 6

Series-Parallel DC Circuits, Methods of Analysis, Network Theorem, Superposition Theorem, Thevenin's Theorem and Maximum Power Transfer, Capacitors, The Oscilloscope, Frequency Response of R, L, And C Components, Phase And Phase Measurements

PHYS 321 Quantum Mechanics I (4+0)4 ECTS 8

The wave function and probability; applications of time-dependent Schroedinger equation to one-dimensional problems including potential well, harmonic oscillator and free particle; applications of Schroedinger equation to three-dimensional problems including hydrogen atom, angular momentum, spin and addition of angular momenta; identical particles with applications.

PHYS 322 Quantum Mechanics II (4+0)4 ECTS 8

Time-independent perturbation theory; the WKB approximation ; time-dependent perturbation theory ; scattering theory comprising partial wave analysis PRCD: PHYS 321

PHYS 326 Statistical Thermodynamics (4+0)4 ECTS 8

The laws of thermodynamics; applications of thermodynamics; basics of probability theory; elementary kinetic theory; classical microcanonical, canonical and macrocanonical ensebles; classical ideal gas; equipartition of energy; quantum mechanical ensebles; ideal Fermi and Bose systems; black body radiation; phonons and electron gas.

PHYS 431 Condensed Matter Physics I (3+0)3 ECTS 9

Crystal diffraction; crystal binding; phonons and lattice vibrations; thermal, acoustic and optical properties; free electron model; energy bands, electron-phonon interactions; semiconductors; transport properties.

PHYS 432 Condensed Matter Physics II (3+0)3 ECTS 9

Dielectric properties; diamagnetism and paramagnetism; ferromagnetism and anti-ferromagnetism; magnetic resonance; electron-phonon interactions; superconductivity; optical properties; liquid metals. PRCD : PHYS 431.

PHYS 452 Introduction to Particle Physics (3+0)3 ECTS 9

Introduction to subatomic particles. Charge, mass and spin. Generalizing charge; weak and strong charges. Generalizing spin; weak and strong interactions. Generalizing mass; fundamental spinless particles.

CONTENTS OF THE ELECTIVE COURSES

PHYS 312 Electronics for Physicists (3+0)3 ECTS 6

Semiconductor diodes and diode equivalent circuits, diode applications, Bipolar junction transistors, transistor construction and operation modes, dc biasing bipolar junction transistors, small signal BJT amplifiers, and design operations, junction field effect transistors (JFET): construction and characteristics of JFETs, transfer characteristics, JFET biasing, metal-oxide-semiconductor field effect transistors and different configurations, operational amplifiers and their characteristics for practical applications. Laboratory section includes a variety of selected experiments in the topics given above.

PHYS 313 Environmental Physics (3+0)3 ECTS 6

Phenomena underlying the environmental issues; energy and entropy laws; energy sources of atomic, nuclear, solar, wind and water types; percolation model; climate.

PHYS 314 Astronomy (3+0)3 ECTS 6

Basic concepts in astronomy (parallax method; properties of light, brightness classification; etc.); Solar System, Kepler's Law, Stellar magnitudes, stellar colors, Hertzsprung-Russell diagram, stellar populations (Main Sequence, Red Giants, White Dwarfs), Tools and Astronomy

PHYS 327 Data Analysis I (3+0)3 ECTS 6

Introduction to scientific data analysis; scientific experimentation; units and standard, picturing experimental data. Population and sample, Excel and data analysis. Data distributions I: probability, probability distribution, normal distribution, confidence intervals, the central limit theorem, the t-distribution, population mean and continuous distribution, and expectation value.

PHYS 328 Data Analysis II (3+0)3 ECTS 6

Data distributions II: the binomial distribution and the Poisson distribution. Measurement, error and uncertainity. Least squares I: the equation of straight line, using the line of best fit, linear correlation coefficients, residuals, data rejection, weighted least squares. Least squares II: extending linear least squares, test of confidence, data analysis tools in Excel and the Analysis ToolPak.

PHYS 341 Advanced Physics Internship (0+6)3 ECTS 6

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

PHYS 342 Physics Internship (0+1) NC ECTS 6

An elective physics course during which the student performs research at an industrial research laboratory or at a university.

PHYS 377 Astrophysics I (3+0)3 ECTS 6

General properties of stars: stellar magnitudes, angular radii of stars, effective temperatures of stars and stellar spectra; electromagnetic radiation and matter: atomic structure, blackbody radiation, Planck's Radiation Law, Stefan-Boltzmann Law, Wien's Law; hydrostatic equilibrium equation; Virial theorem; energy generation and transport in stars.

PHYS 378 Astrophysics II (3+0)3 ECTS 6

Overview of stellar structure and evolution, Star deaths: white dwarfs, neutron stars and black Holes, Population I - Population II stars, stellar clusters: Interpreting the H-R diagrams of open and globular clusters, stellar rotation, Stellar magnetic fields, stars with peculiar spectra, pulsating stars, explosive stars, active Sun, interstellar medium, Interstellar absorption.

PHYS 380 Thermal Physics (3+0)3 ECTS 6

Thermal equilibrium, ideal gas, entropy. First, second and third laws of thermodynamics. Interacting ideal gases. Temperature, heat, mechanical equilibrium and pressure. Heat capacities. Heat engines and refrigerators. Liquefaction of gases. Free energy and chemical thermodynamics. Fuel cells and batteries, Gibbs free energy.

PHYS 390 Special Relativity (3+0)3 ECTS 6

Newton's relativity. Michelson-Morley experiment. Essentials of Special Relativity. Einstein's Optics. Space-time and four-vectors. Mechanics of Relativistic Particles. Relativity and electrodynamics.

PHYS 405 Advanced Physics Laboratory (1+4)3 ECTS 6

Single slit diffraction experiment, Solar cell characteristics experiment, Franck-Hertz experiment, Hall-Effect experiment, Experiments on the magnetic properties of materials, experiment on superconductivity.

PHYS 415 Computer Interface for Physics Experiments (3+0)3 ECTS 6

Binary logic instruction and data processing. Principles of parallel port communication for IBM 25-pin, 8 bit parallel port configuration: Input, output, and control ports and their addresses. Computer interfacing: Sensors for computer control. Digital-to-analog conversion, analog-to-digital conversions. Stepper and DC motor control via parallel port. Principles of computer control via IEEE 488.2 GPIB card and device dependent control comments for some commonly used digital electronic measure units such as current source, voltage source and digital multimeter for physics experiments.

PHYS 416 Computational Physics (3+0)3 ECTS 6

Computing Software Basics. Errors and uncertainties in computations. Data fitting. Deterministic randomness. Monte Carlo applications. Differentiation. Differential equations and Oscillations. Anharmonic oscillations. Matrix computing and Subroutine Libraries. Bound states in Momentum space. Computing hardware basics: Memory and CPU. High-performance computing: Profiling and tuning. Thermodynamic simulations: The ising model. Fractals, Heat flow and waves on a string.

PHYS 435 Applied Superconductivity (3+0)3 ECTS 6

Introduction to conventional and high Tc superconductivity:summary. Cooper pairs and BCS theory, Ginzburg-Landau theory, Magnetic properties of Type I and Type II superconductors, Energy Gap, Quasiparticle and Josephson tunneling. Maglev trains, energy transport cables, high field magnets, flywheels, SQUID's, magnetometers, RSQF technology.

PHYS 436 Introduction to Nano Scale Science and Technology (3+0)3 ECTS 6

The top-down approach. The change of physical phenomena; macroscopic to mesoscopic and to nanoscopic scale. The bottom-up approach; design and build new structures and devices by putting single atoms or molecules. The spectroscopies to characterize and study nano-structures artificial superlattices, quantum wells, quantum wires, 2D-patterned structures, quantum dots. Nano- and picoscale spectroscopies; scanning tunnelling, force microscopy, spectroscopy, nano, picoscale imaging. The fabrication of nano-structures and devices; epitaxy, self-assembly, STM manipulation, clusters, carbon nanotubes, nanocomposites, quantum corrals, spin valves, spin transistors, single electron transistors.

PHYS 441 Solid State Device Physics (3+0)3 ECTS 6

Quantum theory of solids, energy bands, electrical conductivity in semiconductors, drift current, effective mass, hole concept, density of states function, Fermi-Dirac distribution function, Semiconductors in equilibrium, charge carriers in semiconductors and extrinsic semiconductors, Carrier transport phenomena: Carrier drift and diffusion, non-equilibrium excess carriers, carrier generation-recombination, quasi-Fermi energy levels, The pn junction: thermal equilibrium characteristics, junction capacitance and diffusion capacitance and reverse breakdown, Metal-

semiconductor contacts: Schottky diode and Ohmic contacts, Bipolar junction transistor (BJT): transistor action and static characteristics of BJT, frequency response and switching of BJT, metal-oxide-semiconductor transistors (MOSFET): two terminal MOS structure, capacitance-voltage characteristics, and the basic MOSFET operation.

PHYS 442 Solid State Device Technology (3+0)3 ECTS 6

Introduction to physics and properties of semiconductors. Epitaxial growth, chemical vapor deposition (CVD) and molecular beam epitaxy (MBE). Thermal oxidation, dielectric deposition, polysilicon deposition and metallization. Lithography and etching. Impurity doping, Diffusion process and Ion implantation. Metal interconnections and contact technology: Metal-semiconductor contacts, polysilicon interconnections and silicide formation. Integrated device technology: p-n junction diode, bipolar junction transistor (BJT), Metal-oxide-semiconductor field effect transistors (MOSFET), MEFET technology.

PHYS 446 Optoelectronic Devices (3+0)3 ECTS 6

Introduction to wave nature of light. Semiconductor fundamentals, pn junction principles and characteristics under light, light emitting diodes (LEDs) and characteristics. Stimulated emission devices-lasers: gas lasers, principles of semiconductor laser diodes, heterojunction lasers, quantum well devices. Photodetectors: principles of pn junction photodiode, pin, avalanche, and heterojunction photodiodes and operation principles. Photovoltaic devices-solar cells and solar cell materials.

PHYS 448 Quantum Optics (3+0)3 ECTS 6

Quantum theory of radiation, coherent and squeezed states of the radiation field, quantum distribution theory and partially coherent radiation, field-field and photon-photon interferometry, atom-field interaction, lasing without inversion, resonance fluorescence. Quantum theory of lasers.

PHYS 453 Molecular Biophysics I (3+0)3 ECTS 6

Molecular forces in biological structures (interactions, force fields, energy functions); Structure and dynamics of biological macromolecules (proteins, enzymes, nucleic acids, lipids…); Compartmentalization of cells; Thermodynamics and bioenergetics; Ionization equilibrium and charge of biomolecules; Physics of neurons; Interaction of radiation with biomolecules; Radiation processes (optic, scattering, absorption).

PHYS 454 Molecular Biophysics II (3+0)3 ECTS 6

A brief introduction to structure and functions of biological macromolecules; Forces and interactions in aqueous solutions; Molecular mechanisms of interactions in biological macromolecules; Enzyme reactions and kinetics; Membrane dynamics and membrane proteins, ion channels; Electrophysiology; Bioelectricity; Gene expression and regulation; microRNAs; Principles and basic concepts of biophysical experimental methods (absorption, dichroism, fluorescence, X-ray diffraction and others; Optical biosensors, optical spectroscopy; Case studies from recent literatures.

PHYS 461 Research Study I (1+4)3 ECTS 6

Directed studies in any area of physics with the motivation to prepare student to develope notions of being a scientific researcher.

PHYS 462 Research Study II (1+4)3 ECTS 6

Directed studies in any area of physics with the motivation to prepare student to develope notions of being a scientific researcher.

PHYS 473 Optics (3+0)3 ECTS 6

Maxwell's equations and electromagnetic waves. Radiometry and photometry. Interfernce and diffraction. Coherence. Matrix methods. Lasers and applications. Introduction to quantum optics.

PHYS 474 Fibre Optics (3+0)3 ECTS 6

Basics of Maxwell's equations and electromagnetic waves. Step index and graded index fibers. Electromagnetic wave propagation in waveguides and optical fibres. Dispersion and attenuation. Optical detection and receivers. Optical amplifiers. Overview of optical fibre production techniques (MCVD, PVD, VAD). Fibre optics Sensors.

PHYS 480 Introduction to General Relativity and Cosmology (3+0)3 ECTS 6

Fundamental principles of Einstein's Theory of General Relativity; Differential Geometry in Physics. Experimental Tests of General relativity. Blackholes. Cosmology.

PHYS 482 Introduction to High Energy Physics (3+0)3 ECTS 6

Review of the basic particle physics phenomenology. Use of Lorentz transformations in elementary particle kinematics. Conservation laws. Gauge principle. Standard model, cross sections and widths. Basic lines of the physics beyond the standard model.

PHYS 496 Introduction to Atmospheric Physics (3+0)3 ECTS 6

Origin and composition, profiles of mass, components, temperature, pressure, and density. Winds and precipitation. Atmospheric thermodynamics. Aerosol and cloud microphysics and cloud types. Radiative transfer and role of radiation in the global energy balance. Atmospheric dynamics, horizontal and vertical equation of motion, thermal wind.