

List of Erasmus classes - summer semesters

Semester	Org. unit.	Name of the subject	The content	Lecture	Class	Lab.	Project	ECTS	Coordinator
2	FF	Physics II	Principles of the theory of electromagnetic field. Gauss' law. Ampere's law. The induction law of Faraday and the Lenz' principle. Maxwell's equations. Electromagnetic waves. Spectrum of electromagnetic waves. Energy of waves. Pointing's vector. Conductivity of solids. Electrical properties of solids. Energy levels in crystals. Semiconductors. Principles of modern relativistic quantum field theory. Elementary particles. Leptons and quarks. Weak and strong interactions. Gauge fields. Strings. Principles of general relativity. Gravitation. Black holes. Relativistic cosmology.	30	45			5	Prof. Vitalii Dugaev, DSc, PhD, Eng.
2	FF	Laboratory: Mechanics	Uncertainty calculus. Determination of bullet flight speed using a ballistic pendulum. Determination of gravitational acceleration using a reverse pendulum. Damped motion study. Measurement of the liquid viscosity by the Stokes method. Measurement of the moment of inertia the Maxwell wheel. Verification of the Newton's second law for rotation of the rigid body. Examination of parameters of the voice wave by the resonance method in the open pipe. Examination of the elastic and inelastic central collisions. Examination of the measurement uncertainties distribution in measurements of the pendulum fluctuation period. Examination of the physical or mathematical pendulum anharmonic. Moments of inertia of rigid bodies determination with a torsional pendulum.			15		1	Tomasz Szczepański, PhD
2	FF	Mathematical Basis of Mechanics	Fundamentals of tensor calculus: scalars, vectors, 2nd order tensors, tensors of any order. Elements of vector analysis: partial derivative differential operations on scalar and vector fields in the Cartesian coordinate system. Examples of 2nd and 4th order tensors in mechanics. Moment of inertia tensor. Stress and strain tensors. Curvilinear coordinate systems. Metric tensor. Lamé coefficients. Differential operators in curvilinear orthogonal systems. Fourier transform in one dimension. Basic properties and examples. Applications.	15	30			3	Tomasz Masłowski, PhD
2	FF	Computer Aided	Introduction to Matlab syntax, basic arithmetic and logical operators, relations, colon operator, access to vector elements, matrix list. Scripts and functions - code			30		2	Michał Ingot, PhD, Eng.

		Engineering Calculations	structure, introducing, running and analysing various calculation variants. Advanced configuration of 2D and 3D graphics - working with input data. Preparation of scripts for multithreaded calculations, time analysis of selected numerical problems in single and multithreaded solutions. Comprehensive analysis of selected engineering problems using the differential and integral equations, work with systems of linear and non-linear equations, fast Fourier transform, calculations of limits and derivatives of functions, functions of one and many variables, matrix calculus. Create your own programs.						
4	FF	Vibrations in Mechanical Systems	Harmonic oscillator equation. Vibrations in a system with one degree of freedom. Damped oscillator. Subcritical and supercritical damping. Periodic exciting force oscillator. Mechanical resonance. Vibrations in systems with two or more degrees of freedom. Lagrangian formulation of dynamics. Concepts: Lagrangian, degrees of freedom, generalized coordinates and velocities, holonomic, nonholonomic, scleronomic constraints. Lagrange's equations of the second kind. Small vibrations around the equilibrium position. Vibrations in one-dimensional continuous systems. String vibration. Nonlinear vibrations. Chaotic oscillations.	15	30			4	Tomasz Masłowski, PhD
4	FC	Geometrical optics in optometry	Light and its parameters. Geometrical optics laws. Lens - types and parameters, ray path, lens equation, optical systems. Structure and physiology of the eye, vision defects and methods of their correction.	15		15		2	Tomasz Więcek, DSc, PhD, Eng. Leszek Pyziak, PhD
4	FC	Photogrammetry in medical engineering	Photogrammetry and its applications. Construction and operation of measurement systems used in photogrammetry. Holography and holographic interferometry. Examples of photogrammetric systems and data processing software.	15		15		2	Tomasz Więcek, DSc, PhD, Eng. Leszek Pyziak, PhD
4	FF	Basics of Surgery	Development and advances in surgery over the last centuries. Qualification of the patient for surgical treatment based on clinical examination. Types of surgical procedures, their scope and the benefits of their application.	15			15	2	Lesław Portas, PhD Michał Wanic, MSc, Eng.

			<p>Preparing the patient for an adequate surgical procedure. Planning the surgical procedure to achieve the best therapeutic results using the least invasive method. Interviewing the patient and attempting to determine the condition based on history and examination in order to qualify for possible surgical treatment. A case analysis of the surgical treatment of patients with a similar disease entity but using different surgical methods. Medical equipment used in surgery. Early assessment of the effect of surgical treatment and attempt to predict the patient's recovery. The reason for using different surgical treatments for similar disease cases but with different therapeutic approaches. Modern surgical treatments using minimally invasive surgical techniques and implants and stimulators. The need for constant monitoring of the patient after surgery is one of the possibilities of increasing the results of treatment effectiveness. Correct and reliable patient qualification, as well as correct history taking and specialist consultations, is one of the basic conditions for surgical success. Alternative and palliative approaches to patient management in borderline surgical eligibility cases. Advances in the eligibility for surgery of patients of advanced age and with conditions that were once considered inoperable. Summary of the classes.</p>						
4	FF	<p>Basics of Orthopedics</p>	<p>History of orthopedics, orthopedic procedures, and orthopedic apparatus and equipment. Orthopedic examination methods, equipment, including diagnostic, used in these tests. Acquired and congenital deformities of the musculoskeletal system. Diagnostic methods, orthopedic apparatus. Bone osteoporosis, diagnostic apparatus and equipment. Traumatic bone injuries, diagnostic methods and apparatus, types of procedures used in trauma, latest orthopedic equipment.</p>	15			15	2	<p>Piotr Biega, PhD Michał Wanic, MSc, Eng.</p>
4	FF	<p>Measurement and Control Systems I</p>	<p>Fundamentals of graphical programming language G - LabVIEW: structured programming elements, variables, data types and operations on them. Application development based on selected design patterns. Characteristics of typical control systems - measurement, communication interfaces and an exemplary embedded real-time system. Serial interfaces RS, SPI, I2C: properties, programming Interface IEEE-488 (GPIB): properties, programming, SCPI command language. Data acquisition modules: structure, properties, programming.</p>	15		30		3	<p>Wiesław Szaj, MSc, Eng.</p>

6	FF	<p>Elements of Nuclear Physics, Radiation Protection</p>	<p>Atom, atomic nuclei, electron shell, atomic ionization Energy. Atomic nucleus, size, density, electric charge, magnetic moment of nucleus, NMR. Nucleons, drop model of atomic nucleus, nuclide stability line, stable nuclides, natural, artificially produced radionuclides, binding energy of atomic nucleus, mass defect. Shell model of the atomic nucleus, energy levels of the nucleus, types of transitions between levels, gamma transitions in the cascade, correlations. Fusion reactions of light atomic nuclei, plasma, nuclear fusion, fusion reactors, hydrogen bomb. Decay reactions of atomic nuclei, energy released during decay. Gamma, alpha, proton, beta, beta plus, neutron radiation. Acceleration of charged particles, deceleration radiation. Radioactivity, Law of radioactive decay, half-life. Nuclear fission reactions, role of neutrons, fission energy, application of nuclear energy, nuclear reactors, nuclear bomb. Interaction of gamma radiation with matter, photoelectric phenomenon, Compton effect, phenomenon of formation of electron-positron pairs, phenomenon of annihilation of electron-positron pairs, active cross sections, linear and mass attenuation coefficient of radiation by matter, law of radiation absorption. Interaction of charged particles with matter, energy loss, range, Bragg curve. Interaction of nuclear radiation with living matter, interaction with biological cell, free radicals, interaction with DNA, cell cycle, cell survival, radiation sickness Nuclear radiation detection, gas detectors, scintillation detectors, semiconductor detectors, gamma quantum counting, electrically charged particle counting, counting statistics, measurement uncertainties. Radiation protection, radiation doses, ALARA principle, radiation warning signs, attenuation of radiation by matter, scattered radiation, shielding properties of matter. Application of nuclear radiation in technology. The use of nuclear radiation in medicine, in diagnostics, in therapy.</p>	15		15		2	Dariusz Twaróg, PhD
6	FF	<p>Radiation in Medicine</p>	<p>Atom, Bohr model, energy levels, energy transitions, electron shells, ionization energy of elements, ionization energy of body components. Atomic nucleus, size, density, electric charge, magnetic moment, atomic nucleus binding energy, mass defect, atomic nucleus stability line. Radiation sources, radionuclides, mass number, atomic number of a nuclide, nuclide designation, abundance of stable, radioactive nuclides, classification of nuclides,</p>	15		15		2	Dariusz Twaróg, PhD

			<p>radioactive nuclides, nuclear transformations, examples of medical nuclides: ^{60}Co, $^{99\text{m}}\text{Tc}$, ^{18}F. Law of decay of a radionuclide, half-life, activity of a radioactive source. Decay of a radionuclide in the body. charged particle accelerations in medical use. Interaction of gamma radiation with matter, photoelectric effect, active cross section, barn unit, Compton effect, differential, total active cross section, creation of electron-positron pair, annihilation of electron-positron pair, annihilation product, positron emission tomography (PET), principle of operation, beta plus radioactive sources. Linear and mass absorption coefficient of gamma radiation, total active cross section, law of gamma radiation absorption, scattered radiation. Interaction of particles having electric charge with matter, interaction of electrons, protons, alpha particles, ions of light elements, energy loss of particles along the track, range of particles in matter, distribution of ionization energy, Bragg curve and its applications in medical therapy. Interaction of neutrons with matter, indirect methods of ionization of matter, interaction of neutron with matter vs. its kinetic Energy. Radiation detection, gas detectors, scintillation detectors, semiconductor detectors, gamma quantum counting, electrically charged particle counting, counting statistics, measurement uncertainties. Definitions of radiation doses, dose relationships, ALARA principle, radiation warning signs, radiation shielding. Interaction of radiation with animate matter, interaction of radiation with biological cell, free radicals, interaction of radiation with DNA, interaction of radiation vs. cell cycle, cell survival, radiation sickness. Medical applications of ionizing radiation, in diagnostics, in therapy, examples of applications, particle acceleration in medical use.</p>					
6	EM	<p>Biomedical Engineering</p>	<p>The origin of biopotentials. ECG signal, ECG standard leads, bioamplifier, ECG recording system. Typical artefacts in ECG signal and denoising methods. Heart electrostimulation - implantable stimulator, defibrillator. Arterial blood pressure measurement - direct/ indirect methods, Oscillometric method, blood pressure continuous monitoring. Korotkoff sounds digital recording and analysis. Blood flow measurement - ultrasonic Doppler flow meter. Peripheral pulse wave recording methods, diagnostic parameters of pulse wave. Pulse oximeter. Measurements in spirometry. Respiratory monitoring.</p>	15		15	2	Barbara Wilk, PhD, Eng.

6	FF	Endoprosthesis, Implants and Artificial Organs		15			15	2	Piotr Biega, PhD Michał Wanic, MSc, Eng.
6	FF	Nanomaterials	History of nanotechnology and nanomaterials. Basic concepts and definitions. Physicochemical properties of nanomaterials and their structure. Division of nanomaterials. Methods of producing nanomaterials. Measuring methods of nanomaterials properties. Safety in working with nanomaterials. Applications of nanomaterials in technology and medicine.	15		15		2	Gaweł Żyła, DSc, PhD, Eng. Jacek Fał, PhD, Eng.
6	FF	Functional Materials	Introduction to materials engineering and its impact on the development of society and industry. A reminder of the fundamentals of solid state physics. Properties of functional materials and nanomaterials. Types of functional materials. Quality of functional materials - test methods and evaluation. Applications of functional materials in technology and medicine. Biomaterials - preparation, properties, and applications.	15		15		2	Gaweł Żyła, DSc, PhD, Eng. Jacek Fał, PhD, Eng
6	FF	Fundamentals of Acoustics and Hearing Protection	Full range of elastic wave frequencies occurring in nature or technically possible, range and division of acoustics; infrasound, sounds, ultrasounds, hyper sounds. General properties of elastic waves, basic phenomena accompanying the propagation of waves in the medium. Voice waves, physical characteristics of sound, sound intensity, area of hearing, sound level and sound pressure level expressed in decibels. The Doppler phenomenon and its application in technology and medicine. Acoustic field, kinematic field sizes: pressure, potential, acoustic impedance, field energy values: acoustic power, energy density, energy flow, energy flow density. Sources of acoustic waves, directional characteristics of acoustic waves source, near field, far field. Attenuation and scattering of acoustic waves in a real center. Prevention of vibroacoustic hazards. Hearing protection, noise reduction methods. Hearing protectors.	15		15		2	Tomasz Masłowski, PhD
6	FF	Ultrasound in	Ultrasound: introduction, history and main applications. Propagation of ultrasonic waves in ideal media. Reflection and refraction. Kinematic and energy quantities. Doppler	15		15		2	Tomasz Masłowski, PhD

		medical applications	effect. The ultrasound propagation in the real medium. Damping, absorption, scattering and diffraction of elastic waves. Characteristics of sound sources. Methods of producing and detecting ultrasound. Ultrasonic transducers. High intensity ultrasound in therapeutic applications. Other applications of ultrasound and prospects for the development of ultrasound methods. Elements of ultrasound tomography.						
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