FACULTY OF PHYSICS AND ASTRONOMY
INSTITUTE OF PHYSICS

ECTS COURSE CATALOGUE

TECHNICAL PHYSICS

specialty: MEDICAL PHYSICS

FIRST DEGREE STUDIES

2013/2014

SEMESTER I:

SEMESTER II:

SEMESTER III:

SEMESTER IV:

SEMESTER V:

SEMESTRE VI:

SEMESTER VII:

INFORMATION TECHNOLOGY

Course code: **11.3-WF-FizTP-TeInf**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Jarosław Kijak, prof. UZ**

Name of lecturer: **dr hab. Jarosław Kijak, prof. UZ**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Laboratory	30	2	I	Grade	

COURSE AIM:

The purpose of education in the field of the information technology is used to teach students basics:
- Word processing,
- Spreadsheets,
- Presentation graphics programs,
- Basics of database management systems.

During the course students acquire the skills laboratory practical use of office software.

ENTRY REQUIREMENTS:

General knowledge of the use of a personal computer, MS office suite and OpenOfice OFFICE.

COURSE CONTENTS:

Exercise program of information technology include:
- Edit text documents
- Advanced text documents
- Create tables, frames
- Advanced editing tools
- Basics spreadsheet
- Advanced Spreadsheet
- Graphics in a spreadsheet
- Design of multimedia presentations
- Fundamentals of database management systems.

TEACHING METHODS:

Laboratory, in which a problem is presented lecture. Students perform the tasks (work from the source document) to illustrate the content of the lecture.

LEARNING OUTCOMES:

Use of computers in education and employment.
Student is able to:
- Independently acquire knowledge and develop their skills, using a variety of sources, and new technologies (K1A_U07).
- Use the information from the available online resources to solve problems in physics and engineering (K1A_U01).
- Perform theoretical analysis and experimental results in a spreadsheet (K1A_U02).

- Use the most popular computer operating systems in the office (K1A_U04).
Students are aware of their knowledge and skills, and understands the need to know the possibilities of continuous further training (for ECDL) (K1A_K01). Understands the need to improve professional and personal competence and uses information from various sources in order to broaden and deepen knowledge (K1A_K04).
Have a working knowledge of computer techniques including (K1A_W05):
- General principles of working in the operating system,
- Basic techniques in the network,
- Data storage and processing,
- Knows and is able to use basic data formats, with particular emphasis on medical formats.
Gained basic knowledge of copyright, intellectual property protection and the use of appropriate licenses (K1A_W09).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Completion of the course is the completion of laboratory exercises. The basis of assessment of laboratories to perform the tasks assigned by the teacher, the teacher Laboratory - point method evaluation of each activity (degree of preparation for classes (34%), the efficiency in the performance of exercise (33%), thoroughness and accuracy of applications (33%).

STUDENT WORKLOAD:

- Participation in the laboratory: 30 hours
- Preparing for the lab: 20 hours
- Consultation: 2 hours

Total: 52 hours, 2 ECTS.

Effort associated with activities that require direct participation of teachers: 32 hours, 1 ECTS.

RECOMMENDED READING:

[1] M. Dziewoński, *OpenOffice 2.0 PL*, Wydawnictwo HELION, Gliwice 2005.

[2] G. Kowalczyk, *Word 2003 PL. Ćwiczenia praktyczne*, Wydawnictwo HELION, Gliwice, 2004.

[3] K. Masłowski K*, Excel 2003 PL. Ćwiczenia praktyczne*, Wydawnictwo HELION, Gliwice 2006.

OPTIONAL READING:

[1] J. Walkenbach, *Excel 2003. Biblia*. Wydawnictwo HELION, Gliwice 2004.

REMARKS: -

MATHEMATICAL ANALYSIS I

Course code: **1.1-WF-FizTP-AMat1**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr Bogdan Roszak**

Name of lecturer: **dr Bogdan Roszak**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					10
Lecture	60	4	I	Exam	
Class	60	4		Grade	

COURSE AIM:

Familiarize students with the basic concepts, theorems and methods used in the differential and integral calculus and their application in dealing with selected technical physics problems.

ENTRY REQUIREMENTS:

Knowledge of mathematics at the secondary school level.

COURSE CONTENTS:

Lecture

I. Elements of logic and set theory

1. Sentential and predicate calculus, operations on sets, Cartesian product of sets.
2. The set theory in equation and inequality solving.

II. Functions of one variable

1. Elementary functions and their properties. The composite and the inverse function.
2. Inverse trigonometric functions. Elementary transformations of function graphs.

III. The limit of number sequences and functions

1. The definition of a number sequence. Monotonicity and boundedness of sequences and functions.
2. Convergence of sequences. Theorems on limits of sequences. The so called sandwich rule in convergence checking.
3. Limits and continuity of functions. Properties of continuous functions.

IV. Series of numbers

1. The concept of the sum of infinite series. The criteria for convergence of the series.

V. Differential calculus of functions of one variable

1. The definition of a derivative, geometric and physical interpretation, the basic rules of differential calculus.
2. Differential of function. Differentiability of functions.
3. The mean value theorems and their applications.
4. De L'Hospital rule and its application in the limits of functions.

5. Taylor and Maclaurin formula.
6. The monotonicity. Local and global extremes.
7. Convex and concave functions. Inflection points of the graph.
8. Examination of a function.
9. Physical applications of differential calculus.

VI. Integral calculus of functions of one variable

1. Antiderivative. The property of indefinite integrals. The rules of integration.
2. Methods for calculating indefinite integrals - integration by parts, integration by substitution, integration of rational functions, integration of trigonometric and irrational function.
3. Definite integral and its properties.
4. The applications of integral calculus in geometry and physics.
5. Improper integrals.

VII. Differential equations

1. Differential equations with separated variables.
2. Homogeneous equations. Inhomogeneous equation.
3. Linear equations of the first and the second order. Bernoulli's equations.
4. Applications of differential equations.

VIII. Vector function of one variable

1. The definition of vector function of one variable.
2. Calculating the derivatives of vector functions (material should be accomplished by the student her or him-self on the basis specified by the lecturer).

IX. Elements of the topology

1. Definition of basic topological concepts.

Exercises.

I. Elements of logic and set theory

1. Performing operations on sentials and sets. Study tautology.
2. Solving equations and inequalities in real numbers domain.

II. Functions of one variable

1. Determining the domain and the range of the function. Checking the properties of the function. Determining the composite and the inverse functions.
2. Constructing and transforming graphs of functions.

III. The limit of number sequences and functions

1. Testing properties of sequences.
2. Calculation of limits of sequences and functions.
3. Checking the properties of continuous functions.

IV. Series of numbers

1. Checking the necessary condition of convergence of the series. Studying the convergence of the series.

V. Differential calculus of functions of one variable

1. Calculating the derivative.
2. The use of de L'Hospital rule to calculate limits of functions.
3. Development of functions in Taylor and Maclaurin series.
4. Studying the slope. Determination of local and global extremes of functions.
5. Determination of inflection points and concavity and convexity intervals.
6. Examination of a function.
7. The usefulness of calculus in dealing with physical problems.

VI. Integral calculus of functions of one variable

1. Integration of functions by the methods from the lecture.
2. Calculation of definite integrals and their geometrical and physical interpretation.
3. Studying convergence of improper integrals.

VII. Differential equations

1. Solving differential equations with separated variables.

2. Solving homogeneous and inhomogeneous equations.
3. Solving linear equations of I and II-order and the Bernoulli equations.
4. The application of differential equations to physical problems.

TEACHING METHODS:

Conventional lectures, exercises auditorium, group work, problem-classical method, the discussion, the use of multimedia.

LEARNING OUTCOMES:

- He knows the basics of mathematical logic and set theory. He knows and understands the concept of a limit of a sequence and a function. He knows what the limit of a series is. He knows and understands the concepts of derivative and differential of function. He knows L'Hospital's rule and can apply it properly . He knows the basic concepts and theorems of integral calculus. The student knows what the differential equation is, and knows several types of the equations. He selects appropriate methods of calculus to cope with a problem (K1A_W02, K1A_W03).
- He is able to examine the logical value of the sentence. He uses the mathematical logic and set theory to solve equations and inequalities. He determines the limit of sequences and functions, and studies their properties. He examines the convergence of a series. He calculates derivatives and uses them in the study of monotonicity, extremes and the concavity and convexity intervals of a function. He can monitor the progress of a function. The student is able to calculate the several types of indefinite integrals. He uses the method of integration by parts and by substitution. He can apply integral calculus to the appropriate physical problems. He solves certain types of differential equations. He can describe physical phenomena by mathematical metods (K1A_U01).
- The student applies a method of self-education. He uses literature and electronic sources, he is able to interpret, analyze and correctly infer on the basis of different sources data (K1A_U07).
- He is aware of his knowledge, skills and understands the need for continuous training and improves his skills (K1A_K01).
- He is able to collaborate and work in the group, taking in the various roles (K1A_K02).
- The student understands the need to improve her or his professional skills by using various sources of information (K1A_K04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: positive evaluation of the test. Classes: positive evaluation of the written tests.

STUDENT WORKLOAD:

Contact hours
lecture - 60 hours
Exercise - 60 hours
consultation - 10 hours (5 hours for lectures and 5 hours for exercises)
time: 130 hours
Working alone
preparation for the lecture - 20 hours
preparation for exercise - 60 hours
preparation for the written tests - 10 hours
Exam preparation - 10 hours
time: 100 hours
Total for all items: 230 hours (10 ECTS)
Effort associated with activities that require direct participation of teachers: 130 hours, 5,5 ECTS.

RECOMMENDED READING:

[1] R. Rudnicki, W*ykłady z analizy matematycznej*, PWN, Warszawa 2006.
[2] A. Sołtysiak, *Analiza matematyczna, Część I,* (Wykłady z matematyki dla studentów fizyki), Wydawnictwo Naukowe UAM, Poznań 1995.
[3] M. Gewert, Z. Skoczylas, *Analiza matematyczna 1, Definicje, twierdzenia, wzory*, Oficyna Wydawnicza GIS, Wrocław 2005.
[4] M. Gewert, Z. Skoczylas, *Analiza matematyczna 1, Przykłady i zadania*, Oficyna GIS, Wrocław 2005.
[5] W. Kołodziej, *Wybrane rozdziały analizy matematycznej,* PWN, Warszawa 1982.
[6] W. Krysicki, L. Włodarski, *Analiza matematyczna w zadaniach,* cz. 1 i 2, PWN, Warszawa 1992.

OPTIONAL READING:

[1] J. Banaś, S. Wędrychowicz, *Zbiór zadań z analizy matematycznej*, WNT, Warszawa 1994.

[2] G. M. Fichtenholz, *Rachunek różniczkowy i całkowy*, tom I i II, PWN, Warszawa 1995.
[3] W. Kołodziej, *Analiza matematyczna w zadaniach*, PWN, Warszawa 1978.
[4] W. Kołodziej, *Podstawy analizy matematycznej w zadaniach*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1995.
[5] G.I. Zaporożec, *Metody rozwiązywania zadań z analizy matematycznej*, WNT, Warszawa 1976.

PROGRAM PREPARATION:

Dr Bogdan Roszak

ALGEBRAIC AND GEOMETRICAL METHODS IN PHYSICS

Course code: **11.1-WF-FizTP-MAiGF**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **prof. dr hab. Andrzej Maciejewski**

Name of lecturer: **prof. dr hab. Andrzej Maciejewski**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	15	1	I	Exam	
Class	30	2		Grade	

COURSE AIM:

To teach the students basic mathematical tools of algebra and analytical geometry necessary to studies of technical physics. To training of applications algebraic and geometric tools to formulate and solve problems of technical physics. To training of usage some very basics abstract mathematical notions as vector space, linear transformation of Euclidean space

ENTRY REQUIREMENTS:

Knowledge of mathematics and physics at the secondary school level

COURSE CONTENTS:

- Complex numbers: Algebraic and trigonometric parametrisations, square roots, roots of unity.
- Matrices: algebraic operations on matrices, classification of matrices, square matrices: determinant and its properties. Methods of determinant's calculations. Systems of Cramer's linear equations and methods of solving them.
- Vector spaces: linear independence of vectors, basis, dimension, sub-space, intersection and sum of subspaces, Linear mapping and their basic properties. Matrix of linear mapping, eigenvalues and eigenvectors, rank of matrix, Kronecker-Capelli theorem,and solving methods of general linear systems.
- Polynomials of one variable: operations on polynomials, division of polynomials, roots of polynomials, fundamental theorem of algebra
- Elements of analytical geometry: curves on plane and in space, tangent and normal to curves, various forms of the straight line equation, conics in Cartesian and polar coordinates, equation of the plane in space, surfaces, quadrics.
- Euclidean spaces: scalar product, angle between vectors, orthogonal and orthonormal bases, Gram-Schmidt orthogonalisation.

TEACHING METHODS:

Conventional lecture with examples illustrating applications of algebra and analytic geometry in physics.

During class students solve exercises illustrating the content of the lecture, complemented with applications in physics.

LEARNING OUTCOMES:

- Student knows and understands the selected topics of complex number theory, linear algebra and analytic geometry. He knows terminology applied in these domains (K1A_W02).

- Student can use mathematical methods to describe and model physical phenomena and processes (K1A_W02, K1A_W03)

- Student can determine various forms of complex numbers, make calculation on these numbers, knows physical applications of complex numbers. Student makes calculations on matrices, determines determinants and apply determinants to solve Cramer's linear systems. Student knows notion of vector space and its properties as well as example of vector spaces appearing in physics. Student makes various manipulations on vectors. Student knows the notion of linear mapping between vector spaces, determines matrix of linear transformation, calculates eigenvectors and eigenvalues. Student can write equation determining straight line on plane and flat plain in space when various data are given. Students recognise various conics where their equations are given, write equations of conics in coordinate system with translated origin. Student knows physical applications of conics. Student knows characteristic properties of Euclidean spaces and orthogonalise given set of vectors (K1A_W02, K1A_U01, K1A_U07, K1A_U08).

- Student uses various teaching materials in Polish and English (K1A_U07, K1A_U08).

- Student is aware of his knowledge and skills. Student recognise the necessity and knows possibilities of permanent training at higher level studies at university. Student understands necessity of permanent improvement of professional qualifications using various materials and opportunities (K1A_K01, K1A_K04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture:

The course credit is obtained by passing a final written exam composed of tasks of varying degrees of difficulty.

Class:

A student is required to obtain at least the lowest passing grade from tests organized during class.

To be admitted to the exam a student must receive a credit for the class.

Final grade: average of grades from the class and the exam.

STUDENT WORKLOAD:

- Participation in lectures: 15 weeks x 1 hour = 15 hours
- Preparation for lectures: 15 hours
- Preparation for exam: 15 hours
- Participation in class: 15 weeks x 2 hour = 30 hours
- Preparation for class including preparation for tests: 30 hours
- Attending lecturers' office hours: 5 hours

Total: 110 hours, 5 ECTS points.

Workload connected with lectures and class requiring direct participation of the teacher amounts to 50 hours. This corresponds to 2.5 ECTS points.

RECOMMENDED READING:

[1] T. Jurlewicz, Z. Skoczylas, *Algebra liniowa 1*, Oficyna Wydawnicza GiS, Wrocław 2011.

[2] T. Jurlewicz, Z. Skoczylas*, Algebra i geometria analityczna*, Oficyna Wydawnicza GiS, Wrocław 2011.

[3] J. Klukowski, I. Nabiałek, *Algebra dla studentów*, Wydawnictwo Naukowo-Techniczne, Warszawa 1999.

[4] A. Mostowski, M. Stark, *Elementy algebry wyższej*, Państwowe Wydawnictwo Naukowe, Warszawa 1965.

OPTIONAL READING:

[1] R. Leitner, *Zarys matematyki wyższej*, część I, WNT, Warszawa 1995.

[2] A. Mostowski, M. Stark, *Algebra linio*wa, Państwowe Wydawnictwo Naukowe, Warszawa 1977.

[3] E. W. Swokowski, *Calculus with analytic geometry*, Prindle, Weber & Schmidt Publishers, Boston 1983.

PROGRAM PREPARATION:

Prof. dr hab. Andrzej Maciejewski

FUNDAMENTALS OF PHYSICS I – MECHANICS

Course code: **13.2-WF-FizTP-PF1ME**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **prof. dr hab. Adrzej Drzewiński**

Name of lecturer: **prof. dr hab. Adrzej Drzewiński**
dr Lidia Najder-Kozdrowska

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					8
Lecture	45	3	I	Exam	
Class	45	3		Grade	

COURSE AIM:

The first objective of this course is to acquaint students with the development of concepts and methods of physics. Executed in parallel, and most important goal is to get the student's ability for understanding and rigorous description of physical phenomena in the field of mechanics. Thanks to demonstrations accompanying lectures, verbal communication is illustrated by numerous examples.

ENTRY REQUIREMENTS:

Knowledge of mathematics and physics at the high school level

COURSE CONTENTS:

LECTURE:

- *History and methodology of science*: basic physical quantities and their measurement, the international SI system of units, coordinate systems, vectors and vector quantities in physics
- *Kinematics*: kinematics of uniform motion, linear motion, motion in two and three dimensions, velocity and acceleration
- *The dynamics of linear motio*n: the dynamics of material point, force and motion, mass and weight, the principles of Newtonian dynamics, friction
- *Frames of reference*: inertial and non-inertial, Galileo and Lorentz transformations
- *Circular motion dynamics*: uniform circular *motion*, the forces of inertia, the Coriolis force
- *Energy*: kinetic and potential energy, work and power, principle of the conservation of energy
- *Collisions*: momentum and the principle of conservation of momentum, elastic inelastic collisions
- *Gravitational interaction*: Kepler's laws, Newton's law of universal gravitation, the work force in a gravitational field, the first and second cosmic velocity
- *Rotary rigid body motion*: rigid body, center of mass, the principle of Steiner's, progressive and rotary motion, the principle of conservation of angular momentum
- *Statics*: a state of equilibrium, inclined plane, equilibrium of rigid bodies
- *Oscillatory motion and waves*: deformation of the bodies, harmonic vibrations, the elastic wave motion and the principle of superposition, interference and diffraction, standing waves, Doppler effect

- *Statics and dynamics of fluids*: Archimedes' principle, Pascal's law, the principle of continuity, Bernoulli's law

CLASS:

- *Vectors.* Adding vectors. Multiplication of vectors.

- *Motion in one dimension.* Average and instantaneous velocity. Accelerated motion. Freely falling bodies.

- *Motion in two and three dimensions.* Position, velocity, acceleration. Projectile motion. Relative motion. *Newton's laws.* Force, mass. Applications of Newton's laws. Frictional forces.

- *Work and energy.* Work done by a constant force and by a variable force. Kinetic energy and the work. Power.

- *Conservation of energy.* Conservative forces. Potential energy. One-dimensional conservative systems.

- *System of particles.* Two- and many-particle systems. Center of mass. Linear momentum of a particle and system of particles. Conservation of linear momentum.

- *Collisions.* Conservation of momentum during collisions. One- and two-dimensional collisions. *Rotational kinematics.* Rotational motion. The rotational variables. Rotation with constant angular acceleration. Relationship between linear and angular variables.

TEACHING METHODS:

Classes are in the form of lectures illustrated with demonstrations. During the lecture the student is encouraged to ask questions, while during the demonstration the students are also encouraged to actively participate. On the exercises, students analyze and solve problems with a teacher.

LEARNING OUTCOMES:

The student knows the principles of modern science methodology (K1A_W01, K1A_W05, K1A_U01, K1A_U06, K1A_U07, K1A_K01, K1A_K03, K1A_K05). Student knows the principle of superposition of forces and the principle of superposition of motions (K1A_W03). Student knows and is able to apply Newton's principles (K1A_W01, K1A_U05). Student can describe the phenomenon in both the inertial and non-inertial reference frames (K1A_W03, K1A_U02). Student knows the law of universal gravitation (K1A_W01) and can apply to motion of the planets (K1A_W03). Understand the relationship between energy and work and can give various examples of potential energy (K1A_W01, K1A_U06). Student knows the conservation laws in mechanics (K1A_W01 and can use them to solve problems of mechanics (K1A_U02, K1A_U05). Student understands the role of inertial mass and its distribution in the analysis of rigid body motion and is able to calculate the moment of inertia for the basic bodies, like a ring, rod or ball (K1A_W03, K1A_U02, K1A_U05). Can describe wave motion and the superposition principle (K1A_W01, K1A_U06). Student understand the general method in physics: breaking problems down into idealized models (K1A_W01), as the perfectly elastic collision or an ideal fluid with zero viscosity. Based on the concept of work and energy can explain Bernoulli's Pronciple (K1A_U02, K1A_U06), and apply them to simple problems of fluid dynamics (K1A_U02, K1A_U05).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The exam is conducted in writing. Student receives four issues to consider requiring the knowledge of the issues and ability to combine different phenomena. For each task, one can get from 0 to 5 points. Received a positive rating requires at least 8 points (a sufficient for 8-10.5 points, a plus sufficient for 11-13.5 points, a good 14-16, a plus good 16.5-18.5 points, a very good 19-20 points).
The basis of assessment exercises is attendance and passing written tests.

The exercises must be completed before the exam begins.
The final grade is the weighted grade from two parts: exercises (40%) and final exam (60%).

STUDENT WORKLOAD:

- Participation in the exercises: 45 hours
- Preparation to the exercises: 45 hours
- Consultations: 5 hours
- Participation in the lectures and demonstrations: 45 hours
- Exam preparation: 40 hours
- Exam: 2 hours

Total: 182 hours, 8 ECTS.

Effort associated with activities where the participation of teachers is required: 97 hours, 4 ECTS.

RECOMMENDED READING:

[1] D. Halliday, R. Resnick, J. Walker, *Podstawy fizyki*, tom 1 i 2, Wydawnictwo Naukowe PWN, Warszawa 2005.

[2] B. Jaworski, A. Dietłaf, L. Miłkowska, G. Siergiejew, *Kurs fizyki*, tom 1, PWN, Warszawa 1976.

[3] I. W. Sawieliew, *Kurs fizyki*, tom 1, Wydawnictwo Naukowe PWN, Warszawa 2002.

[4] L. D. Landau, J. M. Liftszyc, *Mechanika*, Wydawnictwo Naukowe PWN, Warszawa 2007.

OPTIONAL READING:

[1] A. K. Wróblewski, *Historia fizyki*, Wydawnictwo Naukowe PWN, Warszawa 2007.

PROGRAM PREPARATION:

Prof. dr hab. Andrzej Drzewiński

METROLOGY

Course code: **13.2-WF-FizTP-TePoM**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr inż. Artur Barasiński**

Name of lecturer: **dr inż. Artur Barasiński**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Class	15	1	I	Grade	

COURSE AIM:

The aim of the course is to familiarize students with the problems associated with the planning and execution of the experiments as well as the analysis of measurements data. A glossary of basic terms used in metrology (measurement, uncertainty of measurement, etc.), useful estimation method, the method of least squares will be introduced.

ENTRY REQUIREMENTS:

The knowledge of physics and mathematics according to the level of secondary school.

COURSE CONTENTS:

- International System of Units SI. Basic units, additional and blended. Suffixes. Classification, characterization and selection methods.
- The analysis and presentation of results. Smoothing and filtering data.
- Application of Lagrange and Newton interpolation. The method of least squares.
- Statistical analysis of the measurements. Probability distributions (uniform, normal, t-distribution, the Fisher-Snedecor, Chi-square, binomial, multinomial, Poisson) and the empirical estimation rules.
- Statistical hypotheses and their verification. Analysis of variance. Regression and correlation.
- Uncertainties and measurement errors
- Static properties of measuring devices. Methods and main measuring systems

TEACHING METHODS:

Explaining, demonstrating, collaborating.

LEARNING OUTCOMES:

- The student has a general knowledge of the methods of physical measurements that allows to understand the basic physical phenomena of the surrounding world, knows the cause-effect relationship (**K1A_W01, K1A_U01, K1A_U02**).

- The student understands and can explain the course descriptions of physical phenomena and processes, can independently play the theorems and laws and selected calculations, can create a theoretical model of the phenomenon and tie it with the results of measurements (**K1A_W02, K1A_W03, K1A_U06**).

- The student can relate the metrology knowledge to medical measurement (**K1A_W05**).

- Students apply the methodology of physical measurements and solutions of the engineering tasks to solve practical problems; is able to plan, perform simple physical measurements, analyze measurement data, interpret and present the results of measurement (**K1A_W02, K1A_U03**).

- Is aware of the importance of behavior in a professional, ethical values and respect for the diversity of views (**K1A_K03**)

- Understands the need to improve skills and personal use of different sources of information (K1A_K04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The final mark consists of:
- The quality of preparation for exercise (discussion, the activity during class time) - 35%
- The quality of prepared statements - 15%
- Final test - 50%

STUDENT WORKLOAD:

- The participation in classes: 15 hours

- The preparation to classes: 15 hours

- The preparation to the test: 10 hours

- Participation in consultation: 2 hours

Total: 42 hours, 2 ECTS points.

Effort associated with activities that require direct participation of teachers: 17 hours, 1 ECTS.

RECOMMENDED READING:

[1] H. Szydłowski, *Niepewności w pomiarach*. Wydawnictwo Naukowe UAM, 2001.

[2] H. Szydłowski, *Teoria pomiarów*, PWN, Warszawa 1974.

[3] J. R. Taylor, *Wstęp do analizy błędu pomiarowego*, PWN, Warszawa 2002.

[4] A. Strzałkowski, A. Śliżyński, *Matematyczne metody opracowywania wyników pomi*arów, PWN, Warszawa 1973.

[5] S. Brandy, *Analiza danych*, PWN, wyd. 2, Warszawa 1999.

OPTIONAL READING:

[1] E. M. Mikhail, G. F. Gracie, *Analysis and adjustment of survey measurements*, van Nostrand Reinhold Company 1981.

[2] E. M. Mikhail, F. Ackermann, *Observations and Least Squares*, IEP---Dun, 1976.

[3] R. Nowak, *Statystyka dla fizyków*, PWN, Warszawa 2002.

PROGRAM PREPARATION:

Dr inż. Artur Barasiński

INTRODUCTION TO BIOLOGY AND MEDICAL BIOLOGY

Course code: **13.1-WF-FizTP-WdBBM**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr Krystyna Walińska**

Name of lecturer: **dr Krystyna Walińska**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					3
Lecture	30	2	1	Exam	

COURSE AIM:

The aim of the course in general botany is to acquire by the student the theoretical knowledge, as a result, the student should describe the stages of biogenesis, chemical and cellular structure of living organisms, present methods of cell ultrastructure study using microscopy methods, explain the process of growth, development and differentiation of organisms, describe the basis of heredity and explain the essence of the human body homeostasis.

ENTRY REQUIREMENTS:

Knowledge of basic biology, including the cytology, histology and genetics at the secondary school level.

COURSE CONTENTS:

Subject matter and scope of biology. Biogenesis. The chemical structure of living organisms. Basics of microscopy. Basics of cytology and histology. Karyokineses and its biological role. Control of the cell cycle. Programmed cell death - apoptosis. Classical genetics - inheritance rights. Basics of molecular genetics. Basics of ontogeny. Introduction to embryology. Stem cells. Homeostasis of the human body.

TEACHING METHODS:

- Oral presentation (in the form of the ppt presentation)

LEARNING OUTCOMES:

- Knows and understands the basics of general biology (cytology and histology of living organisms, including humans) (K1A_W04).
- Explains the rules of inheritance and the basis of ontogeny and homeostasis of the human body (K1A_W04).
- Knows basics of microscopy (K1A_W12).
- Can independently acquire knowledge, develop their skills, using a variety of sources and known techniques (analysis using a microscope). Uses skills in a professional environment and other environments (K1A_U07).

- Can elaborate a topic which present specific problem by integrating knowledge of physics and bio-medical science (K1A_U05).

- Applies the method of self-education and recognizes the need to learn and improve their skills in biology (K1A_K01).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The lectures - the student is allowed to take the final written examination test. The 60 minute examination test contains 70 closed questions. 42 points (60%) out of 70 points are required to get the pass mark credit.

STUDENT WORKLOAD:

The contact hours: - the lectures (30 hours), the consultations (4 hours), the examination test (2 hours). The unassisted student work: - the examination preparations (30 hours). The total amount of 66 hours refer to 3 ECTS points.

The determined student workload include: the workload of the direct assistance of the academic teacher: 30+4+2 = 36 hours which refer to 2 ECTS points, - the practical workload (the unassisted student learning): 30 hours which refer to 1,5 ECTS points.

RECOMMENDED READING:

[1] P. T. Kąkol Piotr, *Biologia Kompendium*, Świat książki, 2010.

[2] Praca zbiorowa (red. A, Czubaj), *Biologia (ze ślimakiem)*, PWRiL, Warszawa 1999.

[3] Solomon, Berg, Martin, Villee, *Biologia*, Multico Oficyna Wydawnicza, Warszawa 200.

[4] B. Alberts (red), Podstawy biologii komórki, Wyd. Nauk. PWN, Warszawa 2007.

OPTIONAL READING:

[1] W. Jarygin, *Biologia, Podręcznik dla studentów kierunków medycznych*, PZWL, 2003.

[2] W. Rawicki, *Histologia*. Wyd. Lek. PZWL, Warszawa 2005.

[3] P. C. Winter i in., *Genetyka*, Wyd. Nauk. PWN, Warszawa 2005.

[4] R. Bruce, *Genetyka człowieka*. Wyd. Nauk. PWN, Warszawa 2002.

PROGRAM PREPARATION:

Dr Krystyna Walińska

ENGLISH AS A FOREIGN LANGUAGE

Course code: **09.0-WF-FizTP-JAng2**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **mgr Grażyna Czarkowska**

Name of lecturer: **mgr Grażyna Czarkowska**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Laboratory	30	2	II	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to further develop ability to use grammar structures which describe present and past activities and are used to form questions.

The course will introduce elements of the language of mathematics and physics – basic vocabulary used in number theory, expressions used to describe basic operations in mathematics and basic vocabulary used to describe phenomena discussed in mechanics and dynamics.

ENTRY REQUIREMENTS:

A2 of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will learn how to:

- describe present and past activities using appropriate grammar tenses (8 hours)
- form basic questions in English - question words and auxiliary verbs (2 hours)
- exchange and get information in everyday life situations (3 hours)
- have a simple conversation in English (3 hours)
- read and understand texts describing present and past (4 hours)
- develop listening comprehension (2 hours)
- express opinions on social phenomena in a discussion in English (2 hours)
- read numbers – ordinal, cardinal, fractions (common, decimal) (2 hours)
- read dates and mathematical operations (2 hours)
- read with understanding simple specialist texts concerning basic notions of mechanics and dynamics (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level A2+ of the Common European Framework of Reference for Languages (K1A_W10, (K1A_U07, K1A_U8, K1A_U9, K1A_U10).

Upon successful completion of the course, the students:

- are able to describe present and past activities using simple grammar structures-tenses
- can form simple questions in English
- give basic information concerning everyday life – personal data, habits, preferences
- are able to get information concerning everyday life
- are able to have simple conversations
- understand non-specialist texts describing present and past activities
- can read numbers – cardinal, ordinal, fractions
- can read dates and basic mathematical operations
- understand simple specialist texts concerning mechanics and dynamics
- are able to work in a team

The student can effectively communicate in a group and to the extent necessary for the tasks of a medical physicist.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, taking part in discussions and giving a short presentation in English.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 1 hour

Private study:

- preparing a presentation – 3 hours
- getting ready for classes – 20 hours
- revising for tests – 6 hours

Total: 60 hours, 2 ECTS.

RECOMMENDED READING:

[1] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007.

[2] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007.

OPTIONAL READING:

[1] *FCE Use of English* by V. Evans.

[2] Internet articles.

[3] L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne.

[4] J. Pasternak-Winiarska, *English in Mathematics*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.

PROGRAM PREPARATION:

Mgr Grażyna Czarkowska

PHYSICAL EDUCATION

Course code: **16.1-WF-FizTP-WFs2**

Type of course: **optional**

Language of instruction: **Polish**

Director of studies: **mgr Tomasz Grzybowski**

Name of lecturer: **Teachers Physical Education and Sports Department**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					1
Class	30	2	II	Pass/Fail	

COURSE AIM:

Development of skills to meet the needs associated with the movement, physical fitness, and care for their own health.

ENTRY REQUIREMENTS:

-

COURSE CONTENTS:

General characteristics and basic rules of selected sport disciplines. Practical skills in selected sports. Health education through physical education and sport.

TEACHING METHODS:

Lectures, practical exercises, group activities

LEARNING OUTCOMES:

Knowledge: Student know the impact of physical activity on the proper functioning of the body; know the health risks resulting from unhygienic living; have a basic understanding of the rules and principles of playing different sports

Skills: Student is able to diagnose the state of his/her physical fitness; can use various forms of activities depending on the state of health, well-being, atmospheric conditions; carries out various forms of physical activity independently and is aware of its impact on the functioning of the body

Competence: Student is able to function in the group with the principles of social coexistence, responsibility for the safety of myself and others, helping less efficient is able to compete with the principles of "fair play", showing respect for the competitors and understanding for differences in the level of physical fitness; knows the health hazards due to the improper use of the sports equipment and appliances

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Exercise - credit on the basis of progress, commitment and student activities in classes and skills in the chosen sports.

Knowledge: observation of the student behaviour during the physical activity

Skills:

- Physical education (standard level) assessment of physical fitness and motor skills using standardized tests determining the level of motor development and technical skills

- Physical education (low level of physical fitness) evaluation of the student's knowledge of diagnostic methods for health and physical fitness and the ability to use exercise to improve movement dysfunction, physiological and morphological with the individual (depending on the type of disability) indicators of the body's functions

Competence: observation of the student behaviour in competitive Sports and in conditions that require the cooperation in the group (K1A_K01, K1A_K06).

STUDENT WORKLOAD:

Contact hours: 30 hours, 1 ECTS

RECOMMENDED READING:

[1] M. Bondarowicz, *Zabawy i gry ruchowe w zajęciach sportowych*, Warszawa 2002.

[2] T. Huciński, E. Kisiel, *Szkolenie dzieci i młodzieży w koszykówce*, Warszawa 2008.

[3] R. Karpiński, M. Karpińska, *Pływanie sportowe korekcyjne rekreacyjne*, Katowice 2011.

[4] A. Kosmol, *Teoria i praktyka sportu niepełnosprawnych*, Warszawa 2008.

[5] T. Stefaniak, *Atlas uniwersalnych ćwiczeń siłowych*, Wrocław 2002.

[6] J. Talaga, *ABC Młodego piłkarza. Nauczanie techniki*, Warszawa 2006.

[7] J. Uzarowicz, Siatkówka. Co jest grane? Wrocław 2005

[8] B. Woynarowska, *Edukacja zdrowotna Podręcznik akademicki*, Warszawa 2010.

[9] J. Wołyniec, *Przepisy gier sportowych w zakresie podstawowym*, Wrocław 2006.

OPTIONAL READING: -

REMARKS: -

MATHEMATICAL ANALYSIS II

Course code: **11.1-WF-FizTP-AMat2**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr Bogdan Roszak**

Name of lecturer: **dr Bogdan Roszak**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	II	Exam	
Class	45	3		Grade	

COURSE AIM:

Familiarize students with the advanced methods and potential abilities of differential and integral calculus of several variables and their application in dealing with selected technical physics problems that are essential in further education.

ENTRY REQUIREMENTS:

Mathematical analysis I, Algebraic and geometrical methods in physics

COURSE CONTENTS:

- Partial Derivatives. Differentials in applications. Chain Rules for Functions of Several Variables. Directional Derivatives and Gradients. Tangent Planes and Normal Lines.
- Extreme Values of Functions of Several Variables. Extreme Values of Functions Defined on Restricted Domains. Implicit Functions. Constrained Optimization problems and the Method of Lagrange Multipliers. Applications in Geometry, Physics and Economy.
- Double Integrals. Volume and Surface Area. Double Integrals in Polar Coordinates. Moments and Center of Mass.
- Triple Integrals and Applications. Triple Integrals in Cylindrical and Spherical Coordinates. Change of Variables and the Jabionan of a Transformation.
- Line Integrals and their Applications. Conservative Fields and Independence of Path. Geen's Theorem.
- Surface Integrals and Their Applications. Gradients, Divergence, Curl as Differential Operators. Gauss' Divergence Theorem and Stokes' Theorem.
- Introduction to Probability Theory. Relative Frequency and Axioms of Probability. Conditional Probability, Independent Events, Theorem of Total Probability, Bayes' Theorem.

TEACHING METHODS:

The problem-solving lecture, a seminar lecture, the use of multimedia, demonstrating method. The discussion method classes, the problem-classical method, solving exercises illustrating the content of the lecture.

LEARNING OUTCOMES:

After completing the course a student is able to recognize, select and apply the classical theorems and methods of differential and integral calculus of severable variables

- in finding extreme values of a function, in constrained optimization problems,

- in geometrical problems such as measure properties of a solid, tangent plane and normal vector to a differentiable manifold,

- and physical problems such as vector fields, work, conservative fields, interpretation of main differential operators (K1A_W02, K1A_W03, K1A_U01, K1A_U02).

The student can apply the basics of probability theory in scientific investigation involving randomness (K1A_W02, K1A_W03, K1A_U01, K1A_U02).

The student make use of variety of materials available in Polish as well as English resources (K1A_U07).

The student is able to present and confront his opinion and persuasion during discussion, analyzing and solving scientific problems in the classroom (K1A_K01, K1A_K02, K1A_K04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture:

The course credit is obtained by passing a final exam composed of written part and conversation.

To be admitted to the exam a student must receive a credit for the class.

Class:

A student is required to obtain at least 50% of maximal score in two tests organized during classes. The student with the lowest passing grade of 10% of maximal score may write a correction test before the exam.

The grade depends as well of active participation in classes and suitable preparation.

Final grade: the average of grades from the class and the exam.

STUDENT WORKLOAD:

Contact hours:

Lecture – 60 hours

Class – 45 hours

Consultation – 5 hours

Time: 80 hours

Working alone:

Preparation to the lecture – 5 hours

Preparation to the classes – 10 hours

Preparation to the tests – 10 hours

Preparation to the exam: 15 hours

Time: 40 hours

Total time for all items: 120 hours (5 ECTS.)

Effort associated with activities that require direct participation of the teacher: 80 hours (3 ECTS)

RECOMMENDED READING:

[1] M. Gewert, Z. Skoczylas, *Analiza matematyczna 2, Definicje, twierdzenia, wzory*, Oficyna Wydawnicza GIS, Wrocław 2005.

[2] M. Gewert, Z. Skoczylas, *Analiza matematyczna 2, Przykłady i zadania*, Oficyna GIS, Wrocław 2005.

[3] M. Gewert, Z. Skoczylas, *Elementy analizy wektorowej, Teoria, przykłady i zadania*, Oficyna GIS, Wrocław 1998.

[4] W. Krysicki, L. Włodarski, *Analiza matematyczna w zadaniach,* cz. 2, Warszawa 1992.

[5] R. Leitner, *Zarys matematyki wyższej dla studentów cz. II, wydanie ósme,* Wydawnictwa Naukowo-Techniczne 1998

[6] Ron Larson, Bruce H. Edwards, *Calculus, 9th Edition,* Cengage Learning 2010.

OPTIONAL READING:

[1] F. Leja: Rachunek różniczkowy i całkowy, PWN, Warszawa 1972.
[2] R. Adams, C. Essex, *Calculus - A Complete Course 7th ed* - (Pearson Canada, 2010) BBS.
[3] Earl W. Swokowski, *Calculus with Analytic Geometry Alternate Edition* – PWS Publisher 1983.

PROGRAM PREPARATION:

Dr hab. Bogdan Roszak

FUNDAMENTALS OF PHYSICS II – THERMODYNAMICS

Course code: **13.2-WF-FizTP-PF2Te**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Maria Przybylska, prof. UZ**

Name of lecturer: **dr hab. Maria Przybylska, prof. UZ**
dr Wojciech Lewandowski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					4
Lecture	30	2	II	Exam	
Class	30	2		Grade	

COURSE AIM:

The aim of the course is to rise the student's ability to understand and precisely describe physical phenomena in the language of thermodynamics and statistical physics. In addition, students learn about the development of concepts and methods in physics. Lecture is enriched with demonstrations illustrating the laws of physics and their applications.

ENTRY REQUIREMENTS:

Knowledge of mathematics and physics at the secondary school level, finished course “Fundamentals of physics I'

COURSE CONTENTS:

- Basis notions of thermodynamics: work, heat, internal energy
- The zeroth law of thermodynamics: measure of temperature, temperature's scales
- Specific heat and material properties: thermal expansions of fluids and solids, heat capacity, specific heat, latent (hidden) heat
- Heat and work: the first law of thermodynamics, thermodynamic processes
- Heat transfer modes: thermal conductivity, convection, radiation
- Model of ideal gas: assumptions of this model, equation of state for an ideal gas, thermodynamic processes for ideal gases
- Kinetic theory of gasses: relation of pressure and temperature to the average value of the square of the velocity of molecules, Maxwell distribution of velocities, mean free path
- The second law of thermodynamics: entropy, thermal engines, Carnot's engines, efficiency coefficient
- The third law of thermodynamics: reversible and irreversible processes; systems: open, closed and isolated; absolute zero temperature; cooling and obtaining very low temperatures
- Elements of statistical physics: probability, microstates and macrostates, statistical sum, entropy, microcanonical and canonical ensembles, statistical definition of temperature; open systems, grand

canonical ensemble, bosons and fermions, the Fermi-Dirac and the Bose-Einstein statistics, photon gas in the cavity and Planck's radiation law, the blackbody spectrum

Random walks: Brown motions, diffusion, diffusion coefficient, abnormal diffusion

- Models of real gases: van der Waals state equation

- Elements of phase transitions physics: fluctuations, phase diagrams, phase transitions of first kind and continuous transitions

TEACHING METHODS:

Conventional lecture illustrated with demonstrations of physical experiments

During classes students analyse and solve exercises illustrating the content of the lecture.

LEARNING OUTCOMES:

- The student understands and can describe the phenomenological and statistical approach to the phenomena of thermodynamics (K1A_W01).

- The student can give the parameters defining the thermodynamic state of the system and define the functions of the state. The student can provide and describe the different forms of energy and its transfer. (K1A_U01).

- Students know, and can apply the principles of thermodynamics to the qualitative and quantitative analysis of simple problems. They can explain how a thermal engine and refrigerator work (K1A_W01, K1A_W03).

- The student can extend the model of an ideal gas to the model of a real gas (K1A_W01, K1A_W02, K1A_W03).

- The student is able to describe the phase transitions of the first kind and continuous transitions using phase diagrams (K1A_U01, K1A_U05).

- The student understands the concepts of microstates and macrostates and can determine the probabilities of their occurrence (K1A_W03).

- The student can define entropy for an isolated system, and give a statistical definition of temperature (K1A_W01, K1A_K05).

- The student knows the basic statistical grand canonical ensembles: microcanonical, canonical and grand canonical ensembles as well as knows applications of these ensembles (K1A_W01).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture:

The course credit is obtained by passing a final written exam composed of tasks of varying degrees of difficulty.

Class:

A student is required to obtain at least the lowest passing grade from tests organized during class.

To be admitted to the exam a student must receive a credit for the class.

Final grade: average of grades from the class and the exam.

STUDENT WORKLOAD:

- Participation in lectures and demonstrations: 15 weeks x 2 hour = 30 hours
- Participation in exam: 2 hours
- Preparation for exam: 20 hours
- Participation in class: 15 weeks x2 hour = 30 hours
- Preparation for class including preparation for tests: 15 hours
- Attending lecturers' office hours: 3 hours

Total: 100 hours, 4 ECTS points.

Workload connected with lectures and classes requiring direct participation of the teacher amounts to 65 hours. This corresponds to 2,5 ECTS points.

RECOMMENDED READING:

[1] A. K. Wróblewski, J. A. Zakrzewski, *Wstęp do fizyki*, (t. 2, cz. 2, roz. VI – Elementy termodynamiki, t. 1, roz. VII – Układy bardzo wielu cząstek), Wydawnictwo Naukowe PWN, 1991 i

1984.
[2] R. Hołyst, A. Poniewierski, A. Ciach, *Termodynamika dla chemików, fizyków i inżynierów*, Wydawnictwo Uniwersytetu Kardynała Stefana Wyszyńskiego, Warszawa 2005.
[3] K. Huang, K. Huang, *Podstawy fizyki statystycznej*, Wydawnictwo Naukowe PWN, Warszawa 2006.
[4] *Slajdy z wykładów*.

OPTIONAL READING:

[1] D. Halliday, R. Resnick, J. Walker*, Podstawy fizyki*, tom 2, Wydawnictwo Naukowe PWN, Warszawa 2005.
[2] I. Anselm, *Podstawy fizyki statystycznej i termodynamiki,* Państwowe Wydawnictwo Naukowe, Warszawa 1990.

PROGRAM PREPARATION:

Dr hab. Maria Przybylska, prof. UZ

CHEMISTRY

Course code: **13.3-WF-FizTP-Chemi**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Jacek J. Kozioł, prof. UZ**

Name of lecturer: **dr hab. Jacek J. Kozioł, prof. UZ**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Lecture	30	2	II	Grade	

COURSE AIM:

Transfer of knowledge on the structure of matter with a particular focus the elements and compounds, and their role in nature, including living organisms,

ENTRY REQUIREMENTS:

Knowledge of chemistry at the high school level

COURSE CONTENTS:

Basic concepts and laws of chemistry. The periodic table of elements. Structure of molecules. Types of chemical bonds. The polarity of the molecules. Acids, bases, salts, amphoteric compounds. Properties of solutions: strong and weak electrolytes, electrolytic dissociation in the water and the concept of pH, hydrolysis of salts. Buffer solutions. Solubility. Types of chemical reactions. Elements of Organic Chemistry: basic types of organic methods for their preparation and their physical and chemical properties

TEACHING METHODS:

by providing (lecture in the form of a multimedia presentation)

LEARNING OUTCOMES:

- have a general knowledge about the basic chemistry (K1A_W01)
- understands and can explain the course of phenomena and descriptions of chemical and physicochemical processes with a special emphasis on medical technology problems (K1A_W03, K1A_W06)
- able to analyze and solve problems based on the physicochemical properties acquired knowledge and information from the available literature sources, databases, Internet resources, both in Polish and foreign (K1A_U01)
- able to perform the analysis of the theoretical and experimental results (K1A_U02)
- are aware of their knowledge and skills, and understands the need to know the possibilities of continuous further training (second-and third-degree, postgraduate) - improving professional and personal competence (K1A_K01)
- understands the need to improve professional skills and personal, using various sources of information in order to broaden knowledge (K1A_K04)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Written test. Test lasting 60 minutes contains 5 issues requiring discussion. To pass the assessment, it is necessary to obtain sufficient 60 points (60%) of 100 points. may be obtained.

STUDENT WORKLOAD:

- Participation in lectures: 15 weeks x 2 hours = 30 hours
- Participation in the consultation: 2 hours
- To prepare for the written test: 15 hours
- Participation in the quiz: 1 hour

TOTAL: 48 hours, 2 ECTS.

Effort associated with activities that require direct participation of teachers: 33 hours, 1 ECTS.

RECOMMENDED READING:

[1] P. A. Cox, *Chemia nieorganiczna*, Wydawnictwo Naukowe PWN, Warszawa 2004.

[2] L. Jones, P. Atkins, *Chemia ogólna*, Wydawnictwo Naukowe PWN, Warszawa 2004.

[3] G. Patrick, *Chemia organiczna*, Wydawnictwo Naukowe PWN, Warszawa 2004.

[4] A. G. Whittaker, A. R. Mount, M. R. Heal, *Chemia fizyczna,* Wydawnictwo Naukowe PWN, Warszawa 2004.

OPTIONAL READING: -

PROGRAM PREPARATION:

Dr hab. Jacek J. Kozioł, prof. UZ

FOUNDATIONS OF PROGRAMMING IN C++

Course code: **11.3-WF-FizTP-PPwJC**

Type of course: **optional**

Language of instruction: **Polish**

Director of studies: **dr Marcin Kośmider**

Name of lecturer: **dr Marcin Kośmider**
dr Krzysztof Krzeszowski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					6
Lecture	30	2	II	Grade	
Laboratory	45	3		Grade	

COURSE AIM:

To teach the students the foundations of C++ programming including elements of objective programming.

ENTRY REQUIREMENTS:

The knowledge of the Linux or Windows operating systems

COURSE CONTENTS:

- Basic concepts and techniques of compiled languages, the **gpp** compiler and the command line, the DevC++ integrated development environment
- The structure of a C++ program, code formating, data types and their representation in computer memory.
- Instructions, declarations and variables, assignment and **cin, cout.**
- Conditionas and the **for** loop.
- Functions.
- Complex types, arrays, strings, structures.
- Introduction to pointers.
- Basics of object oriented programming: polymorphism, hermetization, inheritance.
- Files and external data in C++.
- Introduction to the standard library and scientific libraries (Armadillo).
- C++ in physics: simulation and data analysis.

TEACHING METHODS:

Lecture, Computer laboratory

LEARNING OUTCOMES:

The student cal install the necessary software for compilation and source code editing for C++ in the operating system of choice (K1A_W04, K1A_W05, K1A_W09, K1A_U04), he or she can write a simple C++ program using the mechanisms of this language (K1A_W04, K1A_W09) and is able to

compile and run it (K1A_U04). The student is able to write a program for analyzing a small data set and a program for running a simple simulation (K1A_W01, K1A_W02, K1A_W03, K1A_U02, K1A_U04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: passing grade in the final test

Laboratory: mean of the grades awarded for the laboratory tasks, as well as a completion of a project

Before taking the final test the student must get a passing grade for the laboratory

The final grade is a weighted average of the test (60%) and the laboratory (40%) grades

STUDENT WORKLOAD:

- Participation in the lectures: 30h
- Preparation for the lectures: 15h
- Participation in the laboratory: 45h
- Preparation for the laboratory: 15h
- Preparation of the programming project: 27h
- Consultations: 3h

TOTAL: 135 hours, 6 ECTS.

The workload requiring the participation of the teacher: 78 hours, 3,5 ECTS.

RECOMMENDED READING:

[1] Stephen Prata, *C++ Primer Plus*, SAMS, 2005.

OPTIONAL READING:

[1] Andrew Koenig, Barbara Moo, *Accelerated C++: Practical Programming by Example*, Addison-Wesley, 2000.

PROGRAM PREPARATION:

Dr Marcin Kośmider

INTRODUCTION TO SCRIPTING LANGUAGES

Course code: **11.3-WF-FizTP-PoJSk**

Type of course: **optional**

Language of instruction: **Polish**

Director of studies: **dr Marcin Kośmider**

Name of lecturer: **dr Marcin Kośmider**
dr Krzysztof Krzeszowski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					6
Lecture	30	2	II	Grade	
Laboratory	45	3		Grade	

COURSE AIM:

To teach the students the foundations of the Python programming including elements of objective programming.

ENTRY REQUIREMENTS:

The knowledge of the Linux or Windows operating systems

COURSE CONTENTS:

- Introduction to scripting languages and to Python
- Lists and tuples
- Strings and dictionaries
- Conditionals, loops and other related constructions
- The idea of abstraction and functions
- Obiect oriented programming: polymorphism, hermetization, inheritance
- Exceptions, elements of debugging Python programs
- Python standard library
- Files
- The applications of Python in physics: simulations and data analysis

TEACHING METHODS:

Lecture, Computer laboratory

LEARNING OUTCOMES:

The student cal install the necessary software for interpretation and source code editing for Python in the operating system of choice (K1A_W04, K1A_W05, K1A_W09, K1A_U04), he or she can write a simple Python program using the mechanisms of this language (K1A_W04, K1A_W09) and is able to and run it (K1A_U04). The student is able to write a program for analyzing a small data set

and a program for running a simple simulation (K1A_W01, K1A_W02, K1A_W03, K1A_U02, K1A_U04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: passing grade in the final test.

Laboratory: mean of the grades awarded for the laboratory tasks, as well as a completion of a project.

Before taking the final test the student must get a passing grade for the laboratory.

The final grade is a weighted average of the test (60%) and the laboratory (40%) grades

STUDENT WORKLOAD:

- Participation in the lectures: 30h
- Preparation for the lectures: 15h
- Participation in the laboratory: 45h
- Preparation for the laboratory: 15h
- Preparation of the programming project: 27h
- Consultations: 3h

TOTAL: 135 hours, 6 ECTS.

The workload requiring the participation of the teacher: 78 hours, 3,5 ECTS.

RECOMMENDED READING:

[1] Magnus Lie Hetland, *Python: From Novice to Professional*, 2nd Edition, Apress 2008.

OPTIONAL READING:

[1] Mark Lutz, *Programming Python*, O'Reily, 2011.

PROGRAM PREPARATION:

Dr Marcin Kośmider

PHYSICS LABORATORY I - MECHANICS, THERMODYNAMICS

Course code: **13.2-WF-FizTP-LaFMT**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr inż. Artur Barasiński**

Name of lecturer: **dr inż. Artur Barasiński**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					4
Laboratory	30	2	II	Grade	

COURSE AIM:

The main objective of the Laboratory of Physical Education and is to teach basics of metrology and introduction to the experimental physics.

ENTRY REQUIREMENTS:

Foundations of mathematics and physics in the field of thermodynamics, the ability to analyze and visualize data, the ability to determine the measurement uncertainty.

COURSE CONTENTS:

In class the following exercises are performed:

- Determination of the acceleration of gravity using Kater's pendulum
- Determination of the modulus of rigidity by the dynamic methods
- Determination of the dynamic viscosity coefficient
- Determination of the ratio Cp / Cv for air by Clement-Desormesa method
- Determination of the density of liquids and solids by means of the pycnometer
- The investigation of the damped oscillations
- The investigation of the resonance phenomena in forced vibrations
- Verification of the circular motion equations of rigid body
- The investigation of the Joule's second law
- Determination of the specific heat of the liquid
- Submission of the perpendicular vibration
- Quincke's interferometer
- Determination of the speed of sound

TEACHING METHODS:

Laboratory method.

LEARNING OUTCOMES:

- Students have a basic knowledge of classic physics and methodology of physical measurements (K1A_W01).
- Can use the tools of mathematical analysis, algebra for the development of measurement data (K1A_W02).
- Students understand and are able to explain the course of performed physical measurements using the language of mathematics, can rebuild themself theorems and laws of thermodynamics and classical mechanics (K1A_W03).
- Are able to perform the analysis of experimental results, technical solutions and formulate on the basis of relevant proposals, including proposals for the applicability of these results in medical physics, and evaluation of solutions (K1A_U02)
- Can use a physical measurements methodology and the solution of the engineering tasks to solve practical problems, are able to plan, perform simple physical measurements, analyze measurement data, interpret and present the results of measurements (K1A_U03).
- Students have a sense of responsibility for their own work and a willingness to comply with the principles of team work (work in pairs) and shared responsibility for the implementation of tasks (K1A_W07, K1A_K02).
- Performs tasks in a way that ensures their own safety and the environment in this respect safety rules and regulations of the physical laboratory (K1A_K06).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Provided credit semester credit lab is 13 exercises. At the final mark consists of:
- The degree of preparation for exercise (35%),
- Efficiency in the performance measurement (10%),
- The quality of the result (15%),
- Evaluate the accuracy (20%),
- Thoroughness and accuracy of applications (20%).

STUDENT WORKLOAD:

- Participation in class: 15 x 3 = 45 hours
- Preparing for the course: 20 hours
- Preparation of the report: 40 hours
- Consultation: 2 hours

TOTAL: 107 hours, 4 ECTS.

Effort involved in activities that require direct participation of the teacher is 47 hours. This corresponds to 2 ECTS.

RECOMMENDED READING:

[1] S. Szczeniowski, *Fizyka doświadczalna* cz. I, PWN, Warszawa 1972.

[2] H. Szydłowski, *Pracownia fizyczna*, PWN, Warszawa 1979.

[3] D. Halliday, R. Resnick, J. Walker, *Podstawy Fizyki* PWN, Warszawa 2006.

[4] T. Drański, *Ćwiczenia laboratoryjne z fizyki*, PWN, Warszawa 1973.

OPTIONAL READING:

[1] A. Piekara, *Mechanika ogólna*, PWN, Warszawa 1961.

[2] A. Zawadzki, H. Hofmokl, *Laboratorium fizyczne*, PWN, Warszawa 1968.

PROGRAM PREPARATION:

Dr inż. Artur Barasiński

COMPUTER DATA PROCESSING

Course code: **11.3-WF-FizTP-KoPDa**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr Sebastian Żurek**

Name of lecturer: **dr Sebastian Żurek**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Laboratory	30	2	II	Grade	

COURSE AIM:

Course aims to introduce students to the (commercial and open source) tools and techniques of data acquisition, storage and analysis, with special attention given to the medical data

ENTRY REQUIREMENTS:

General computer and mathematics knowledge

COURSE CONTENTS:

- Data in today's world
- Data types
- Medical data
- Data storage and processing tools
- Relational data bases
- Programming and data storage
- Data quality – how data storage methods are related with the project goals
- Software for data analysis
- Statistical data analysis
- Data mining techniques
- Big data
- Data analysis of visual data: file types often used in medicine – DICOM format
- Project and maintenance of heterogeneous data bases
- Population monitoring, graphical and analytical tools
- Scientific project scenario: hypothesis, data storage, follow-ups

TEACHING METHODS:

Computer lab, discussions, individual students readings of technical documentation

LEARNING OUTCOMES:

Student understands the SQL data bases concepts and is able to design the database to model the scientific project data using the commercial and free (open source) software,

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Reports from the three projects developed during the course are required to pass the lab.

STUDENT WORKLOAD:

- Lab: 30 h
- Individual projects workload: 23 h
- Consultations: 2 h

Total 55 hours, 2 ECTS

The workload requiring the participation of the teacher: 32 hours, 1 ECTS.

RECOMMENDED READING:

[1] P. D. Lewis, *R for medicine and biology*, Jones and Bartlett, 2010.

[2] J. J. Berma, *Biomedical informatics*, Jones & Bartlett, 2006.

OPTIONAL READING:

[1] Mark Whitehorn, Bill Marklyn*, Relacyjne bazy danych*, Helion 2003.

[2] A. Molinaro, *SQL Cookbook* , O'Reilly 2006.

PROGRAM PREPARATION:

Dr Sebastian Żurek

HUMAN ANATOMY AND PHYSIOLOGY I

Course code: **13.1-WF-FizTP-AiFC1**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Mariusz Kasprzak, prof. UZ**

Name of lecturer: **dr hab. Mariusz Kasprzak, prof. UZ**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					4
Lecture	45	3	II	Exam	

COURSE AIM:

Knowing the macroscopic organs (body parts, systems, organs) and microstructures (specific individual tissues and cells that build them) of the human body. Link building organs to their function. Physiology of individual systems and the principles of their cooperation in the human body. Extended range of knowledge about the anatomy and function of the locomotor system and the senses.

ENTRY REQUIREMENTS:

Knowledge of human anatomy and physiology at the secondary level.

COURSE CONTENTS:

The building blocks of the human body: cell - characteristics of cell organelles, tissue - and the construction of basic types of tissues, organs and organ systems. Axes and planes of the human body. The human body as a biological system structurally and functionally integrated organs and their systems. Connective tissue: specific, bone, cartilage, fat. Blood.

The skeleton, its features and development. Construction and split bones. The bone. Types and extent of movement of different types of joints. Posture. Hematopoietic function of bone. Types and distribution of adipose tissue in the human body. Muscle tissue. The active part of the locomotor system - cross-striated muscle tissue. Skeletal muscles - construction, topographic and functional division. Locomotion - muscles of the trunk and limbs. Muscle mechanics. Energy muscle contraction. Types of muscle contractions.

Breathing movements.

Nerve tissue. Structure and function of neurons, the nerve path. Central nervous system (brain and spinal cord) and peripheral (cranial and spinal nerves). Breakdown of functional peripheral nervous system - Part somatic, autonomic and sensory. Movement - brain centers, roads and fibers somatic nerve. Muscle reflexes and voluntary movement. Sensation and perception - somatic sensations (skin and muscle receptors), feeling deep, sense organs (eye, ear, smell, taste, balance). Brain centers specific for human cerebral cortex, the limbic system (memory and emotions). Autonomous Action - sympathetic and parasympathetic, integration of neuro-hormonal systems.

TEACHING METHODS:

- Lecture and multimedia presentation

- Presentation and demonstration (charts and anatomical models), educational films characterized by physiological processes

LEARNING OUTCOMES:

- He knows the human anatomy (K1A_W01).
- Understands the importance of a functional organ systems and their constituent units of morphological (K1A_W02).
- Lists and discusses the functional structure of the human (K1A_W03, K1A_W04)
- Recognizes different human organs and indicates the correct position of the body (K1A_U01).
- Sees the human body as an integrated team of morphologically and physiologically organ systems (K1A_U02).
- Recognizes the diagrams of the major organ systems (K1A_U03).
- Using the correct nomenclature of the anatomy and physiology in collaboration with medical staff K1A_U06)
- Able to work independently and in a team (K1A_K01).
- Is interested in the complexity of the construction of the human body and recognizes the importance of a healthy lifestyle (K1A_K02).
- Sustainable development of medical science calls the interest of continuous expansion of knowledge (K1A_K03).
- Understands the need for ethical behavior in working with the material of human origin (K1A_K04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Tests after discussing the part of individual organs - written (test or a description of the process).

50% correct responses results in obtaining a satisfactory evaluation,

75% of the well

over 85% are very good

Final exam, written - test (point rating above.)

STUDENT WORKLOAD:

- Participation in lectures: 45 hours.
- Preparation for the lecture and exam: 40 hours.
- Consultation: 3 hours.
- Participation in the exam: 2 hours.

A total of 90 hours, 4 ECTS.

Effort associated with activities that require direct participation of teachers: 50 hours, 2 ECTS.

RECOMMENDED READING:

[1] *Fizjologia człowieka z elementami fizjologii stosowanej i klinicznej*, red. W. Traczyk, A. Trzebski, PZWL, Warszawa 1990.

[2] W. Z. Traczyk, *Fizjologia człowieka w zarysie*, PZWL, 2005, wyd. VII.

[3] A. Michajlik, W. Ramotowski, *Anatomia i fizjologia człowieka*, PZWL, Warszawa 2001.

[4] A. Bochenek, M. Reicher, *Anatomia człowieka*, PZWL, Warszawa 1993.

[5] E. Suder, S. Brużewicz*, Anatomia człowieka: podręcznik i atlas dla studentów licencjatów medycznych,* Górnicki, Wydawnictwo Medyczne, Wrocław 2004.

OPTIONAL READING:

[1] P. Dąbrowski, B. Kwiatkowska, J, Szczurowski, *Anatomia człowieka, Układ ruchu bierny* (*Systema motorium passivum*), Wyd. Uniwersytetu Wrocławskiego, 1995.

[2] R. Putz, R. Past, *Atlas anatomii człowieka*, Urban & Partner, Wrocław 1994.

[3] J. Bullock, J. Boyle, M. B. Wang, *Fizjologia*, Wydawnictwo Medyczne Urban & Partner, 2004.

[4] B. K. Gołąb, *Anatomia czynnościowa ośrodkowego układu nerwowego,* Wydawnictwo Lekarskie PZWL, Warszawa 2004.

PROGRAM PREPARATION:

Dr hab. Mariusz Kasprzak, prof. UZ

ENGLISH AS A FOREIGN LANGUAGE

Course code: **09.0-WF-FizTP-JAng3**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **mgr Grażyna Czarkowska**

Name of lecturer: **mgr Grażyna Czarkowska**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Laboratory	30	2	III	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to further develop ability to use grammar structures which describe future and life experiences. It will help students to revise structures used to talk about present and past. The course provides an opportunity to learn the skill of writing informal letters.

The students will be able to deepen their knowledge of the specialist language used in the following branches of physics: mechanics, dynamics. They will get familiar with the vocabulary concerning human anatomy and physiology.

ENTRY REQUIREMENTS:

A2+ of the Common European Framework of Reference for Languages specified by the Council of Europe

COURSE CONTENTS:

During the course students will learn to:

- describe present and past activities using more complex language structures -continuous tenses (2 hours)
- describe future activities – predictions, plans (4 hours)
- express offers, suggestions (2 hours)
- talk about life experiences using appropriate grammar tense (4 hours)
- exchange and get information concerning future in everyday life situations (3 hours)
- have longer conversations using familiar vocabulary and language structures (3 hours)
- understand non-specialist texts describing future (4 hours)
- participate in class discussions, express opinions with confidence (2 hours)
- write informal letters (2 hours)
- improve listening comprehension (2 hours)
- master and extend vocabulary used in mechanics, dynamics and human anatomy (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level A2+ of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- are able to describe present and past activities using complex grammar structures and recognize situational context for their application
- are able to describe life experience using appropriate grammar tenses
- are able to express offers and suggestions
- are able to get detailed information concerning everyday life.
- can have longer conversations using more complex structures and vocabulary
- understand non-specialist texts describing future
- have developed listening comprehension to understand longer dialogues
- know expressions and rules used in informal letters
- are able to give simple definitions of motion, force
- are able to get information about topics from mechanics, dynamics and human anatomy
- can deliver a short presenation in English
- understand simple specislist texts concerning mechanics, dynamics and human anatomy
- are able to work in a team

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, participating in class discussions, dialogues, delivering a presentation in English, getting information.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 1 hour

Private study:

- preparing a presentation – 3 hours
- getting ready for classes – 20 hours
- revising for tests – 6 hours

Total: 60 hours, 2 ECTS.

RECOMMENDED READING:

[1] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007.

[2] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007.

OPTIONAL READING:

[1] *FCE Use of English* by V. Evans.

[2] L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne.

[3] Internet articles.

PROGRAM PREPARATION:

Mgr Grażyna Czarkowska

PHYSICAL EDUCATION

Course code: **16.1-WF-FizT-WFs3**

Type of course: **optional**

Language of instruction: **Polish**

Director of studies: **mgr Tomasz Grzybowski**

Name of lecturer: **Teachers Physical Education and Sports Department**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					1
Class	30	2	III	Pass/Fail	

COURSE AIM:

Development of skills to meet the needs associated with the movement, physical fitness, and care for their own health.

ENTRY REQUIREMENTS:

-

COURSE CONTENTS:

General characteristics and basic rules of selected sport disciplines. Practical skills in selected sports. Health education through physical education and sport.

TEACHING METHODS:

Lectures, practical exercises, group activities

LEARNING OUTCOMES:

Knowledge: Student know the impact of physical activity on the proper functioning of the body; know the health risks resulting from unhygienic living; have a basic understanding of the rules and principles of playing different sports

Skills: Student is able to diagnose the state of his/her physical fitness; can use various forms of activities depending on the state of health, well-being, atmospheric conditions; carries out various forms of physical activity independently and is aware of its impact on the functioning of the body

Competence: Student is able to function in the group with the principles of social coexistence, responsibility for the safety of myself and others, helping less efficient is able to compete with the principles of "fair play", showing respect for the competitors and understanding for differences in the level of physical fitness; knows the health hazards due to the improper use of the sports equipment and appliances

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Exercise - credit on the basis of progress, commitment and student activities in classes and skills in the chosen sports.

Knowledge: observation of the student behaviour during the physical activity

Skills:

- Physical education (standard level) assessment of physical fitness and motor skills using standardized tests determining the level of motor development and technical skills

- Physical education (low level of physical fitness) evaluation of the student's knowledge of diagnostic methods for health and physical fitness and the ability to use exercise to improve movement dysfunction, physiological and morphological with the individual (depending on the type of disability) indicators of the body's functions

Competence: observation of the student behaviour in competitive Sports and in conditions that require the cooperation in the group

STUDENT WORKLOAD:

Contact hours: 30 hours, 1 ECTS

RECOMMENDED READING:

[1] M. Bondarowicz, *Zabawy i gry ruchowe w zajęciach sportowych*, Warszawa 2002.

[2] T. Huciński, E. Kisiel, *Szkolenie dzieci i młodzieży w koszykówce*, Warszawa 2008.

[3] R. Karpiński, M. Karpińska, *Pływanie sportowe korekcyjne rekreacyjne*, Katowice 2011.

[4] A. Kosmol, *Teoria i praktyka sportu niepełnosprawnych*, Warszawa 2008.

[5] T. Stefaniak, *Atlas uniwersalnych ćwiczeń siłowych*, Wrocław 2002.

[6] J. Talaga, *ABC Młodego piłkarza. Nauczanie techniki*, Warszawa 2006.

[7] J. Uzarowicz, Siatkówka. Co jest grane? Wrocław 2005

[8] B. Woynarowska, *Edukacja zdrowotna Podręcznik akademicki*, Warszawa 2010.

[9] J. Wołyniec, *Przepisy gier sportowych w zakresie podstawowym*, Wrocław 2006.

OPTIONAL READING: -

REMARKS: -

FUNDAMENTALS OF PHYSICS III – ELECTRICITY AND MAGNETISM

Course code: **13.2-WF-FizTP-PF3EM**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Wiesław Leoński, prof. UZ**

Name of lecturer: **dr hab. Wiesław Leoński, prof. UZ**
dr eng. Artur Barasiński

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					6
Lecture	30	2	III	Exam	
Class	30	2		Grade	

COURSE AIM:

To present the basic concepts of the classical theory of electromagnetism and the expansion of knowledge possessed by the student in the field. Transfer a knowledge in physics enabling for understanding at basic level the phenomena and processes in the classical electric and magnetic systems.

ENTRY REQUIREMENTS:

Skills in calculus and knowledge of the laws of physics at the high school level, and gained during completed courses.

COURSE CONTENTS:

- Basic historical background related to discoveries in the field of electromagnetism
- Basic concepts of electricity, discrete nature of the charge, the principle of charge conservation. The concept of an electric field and electric potential - relationships between them. Electric field lines. Potential energy in electric field. Point charge and electric dipoles - their behavior in the electric field. Coulomb's law, electric flux, Gauss's law, gradient of the field.
- Conductors in electric field, charge distributions in conductors, capacitors, capacity. Connecting of capacitors.
- Dielectrics in an electric field, Faraday's experiment, the polarization of dielectrics, electric susceptibility, polarization, electric displacement, isotropic and anisotropic dielectrics.
- Electricity, the concept of stationarity and homogenity of current, current and its density, resistance and resistivity, temperature dependence of resistance, Ohm law, superconductivity, the microscopic description of electric current, Kirchhoff law, electromotive force, energy and its conversion in electric circuits, combining of resistors, compensation circuit, measuring current and voltage, electrical RC circuit.
- Basic concepts related to magnetic field, definition of the vector of magnetic field induction, Lorentz force, magnetic dipole and its behavior in the magnetic field.
- Ampere's law, Biot-Savart law, forces acting on a current-carrying conductor in a magnetic field, ampere unit - its definition.

- Faraday's induction law, Lenz's law, inductance, LR circuit, energy of magnetic field.

- Gauss' law for magnetism, magnetic materials (para-, dia- and ferromagnetic) Curie law, magnetic field vector, magnetization, magnetic permeability.

- Displacement current, symmetry of equations of electromagnetism, the concept of divergence and curl and their relationship to macroscopic physical quantities, integral Maxwell equations and their differential counterparts.

TEACHING METHODS:

Classical lectures supported by physical demonstrations, classes.

LEARNING OUTCOMES:

Student can describe the processes in the field of electricity and magnetism. Student has a general knowledge of classical and modern physics, physical measurement methods, which allows for understanding of fundamental physical phenomena of the surrounding world and knows the cause-effect relationships (**K1A_W01**). Student understands and can explain physical phenomena and processes using the language of mathematics, can independently reproduce theorems and laws of physics, and selected calculations. Student can create a theoretical model of the phenomenon and find its relationships with the results of measurements (**K1A_W03**). He can also analyze and solve physical problems on the basis of his acquired knowledge and information from the available literature sources, online resources (both in Polish and foreign language) **(K1A_U01)**. The student is able to analyze the theoretical and experimental results and formulate appropriate conclusions on their basis (**K1A_U02**). Moreover, student is able to describe chosen physical problem and provide possible solutions **(K1A_U05).** He is able to acquire by oneself his knowledge and develop his skills using a variety of sources (in Polish and foreign language) and modern technology **(K1A_U07)**. After completing the course the student recognizes social role of the physics graduate. He especially understands the need for formulating and providing the information and opinions on the achievements of physics to the public. In consequence, he endeavors to provide such information and opinions in a widely understood way **(K1A_K05)**.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture - obtaining a positive assessment of the final exam (written). In addition, there is the opportunity to prepare and present a study on the given topic or practical task.

Classes - Positive pass all tests.

Before taking the exam a student must gain positive grade during the class.

Total score: a weighted average rating of the exam (70%) and grade from the class (30%).

STUDENT WORKLOAD:

- Participation in lectures: 30 hours
- Participation in classes: 30 hours
- Preparing for classes: 30 hours.
- Preparing for the exam: 30 hours.
- Consultations: 5 hours.
- Participation in the exam: 2 hours.

Total: 127 hours, 5 ECTS.

Effort related to activities that require direct participation of teachers 67 hours, equivalent to 2,5 ECTS.

RECOMMENDED READING:

[1] D. Halliday, R. Resnick, J. Walker, *Podstawy fizyki T.III, Elektryczność i magnetyzm*, Wydawnictwo Naukowe PWN, Warszawa (any edition).

[2] Materials prepared and supplied by lecturer (available in electronic form).

OPTIONAL READING:

[1] H. Rawa, *Elektryczność i magnetyzm w technice*, Wydawnictwo Naukowe PWN (any edition).

[2] D. J. Griffiths*, Podstawy elektrodynamiki,* Wydawnictwo Naukowe PWN, (any edition).

PROGRAM PREPARATION:

Dr hab. Wiesław Leoński, prof. UZ

PHYSICS LABORATORY I - ELECTRICITY AND MAGNETISM

Course code: **13.2-WF-FizTP-LaFEM**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr Piotr Jachimowicz**

Name of lecturer: **dr Piotr Jachimowicz**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					4
Laboratory	45	3	III	Grade	

COURSE AIM:

The aim of the course is to provide students with the phenomenon of the magnetism and with the chosen effects associated with the flow of an electric current. All experiences exercised during the classes are aimed to demonstrate a close relationships between branches of physics mentioned above. An additional purpose of this course is developing a logical thinking skills among students and their creativity.

ENTRY REQUIREMENTS:

Fundamentals of physics and mathematics, ability of analysis and presentation of data, ability of estimating measuring uncertainties.

COURSE CONTENTS:

In frame of the course the following laboratory exercises are being conducted:

- Determination of the charge and capacity of the capacitor,
- Study of Peltier module,
- Examination of Joule's law of heating,
- Measurement of the electrical resistance, checking Ohm's law,
- Study of circumferences of the direct current (examination of Kirchoff's laws),
- Study of transformer functioning,
- Measurement of the inductance and capacities with technical method,
- Resonance in the series and parallel circumference,
- Measuring the dielectric constant of solid materials,
- Study of relaxation oscillations,
- Measurement of the capacity of the capacitor with using Wheatstone's bridge,
- Experimental study of the electromagnetic resonances,
- Study of the vector of the magnetic induction along the axis of the solenoid with using the magnetron method,
- Study of hysteresis loops,
- Measurement of electrical power in alternating current circuits.

TEACHING METHODS:

Laboratory exercises preceded by the brief conventional or problem lecture are basing methods of teaching.

LEARNING OUTCOMES:

The student has a general knowledge of basic physics (classical and modern), data acquisition and statistical processing of experimental data (K1A_W01). The student understands as well as is able to explain the course of phenomena and physical processes using language of mathematics; is able independently to reconstruct theorems and laws and chosen calculations (K1A_W03). The student understands the structure and the principles of operation of research apparatus applied in physics, is able to make the measurement of the physics quantity and to make his interpretation (K1A_W05). The student knows essentials of health and safety at work (K1A_W06). The student is able to speak intelligible, straight language about physical issues (K1A_U06). The student is able to think and to act in the enterprising way (K1A_K06).

ASSESSMENT METHODS AND CRITERIA:

Form of receiving a credit for a course is a grade. Performing all exercises along with drawing them up in the form of written report is a condition for passing the course. The grade obtained from every exercise consists of:

- grade from the preparation for classes 30%
- grade from the laboratory work 20%
- grade obtained from the report 50%

STUDENT WORKLOAD:

- Participation in classes: 45 hours
- Preparation for classes: 20 hours
- Preparing reports: 40 hours
- Consultation: 2 hours

TOTAL: 107 hours, 4 ECTS.

The workload requiring the teacher's direct participation: 47 hours. It is giving 2 ECTS.

RECOMMENDED READING:

[1] S. Szczeniowski, *Fizyka doświadczalna,* cz. II, PWN, Warszawa 1972.

[2] H. Szydłowski, *Pracownia fizyczna*, PWN, Warszawa 1979.

[3] D. Halliday, R. Resnick, J. Walker, Podstawy fizyki - Elektryczność i magnetyzm t. 3, PWN, Warszawa 2006.

[4] T. Dryński, *Ćwiczenia laboratoryjne z fizyki*, PWN, Warszawa 1972.

[5] A. Zawadzki, H. Hofmokl, *Laboratorium fizyczne*, PWN, Warszawa 1961.

[6] J. Szatkowski, L. Lewowska (red.), *Ćwiczenia laboratoryjne z fizyki, część 3, Elektryczność i magnetyzm,* Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1999.

OPTIONAL READING:

[1] E. M. Purcell, *Elektryczność i magnetyzm*, PWN, Warszawa 1968.

[2] J. Massalski, M. Massalska, *Fizyka dla inżynierów, t.1*, WNT, Warszawa 1975.

[3] H. Szydłowski*, Niepewności w pomiarach. Międzynarodowe standardy w praktyce*, Wydawnictwo Naukowe UAM, Poznań 2001.

[4] R. P. Feynman, R. B. Leighton, M. Sands, *Feynmana wykłady z fizyki*, t. 2 cz. 1, *Elektryczność i magnetyzm, elektrodynamika*, PWN, Warszawa 2009.

[5] R. P. Feynman, R. B. Leighton, M. Sands, *Feynmana wykłady z fizyki,* t. 2 cz. 2, *Elektrodynamika, fizyka ośrodków ciągłych*, PWN, Warszawa 2009.

PROGRAM PREPARATION:

Dr Piotr Jachimowicz

ELEMENTS OF TECHNICAL PHYSICS

Course code: **13.2-WF-FizTP-PoFiT**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Bohdan Padlyak, prof UZ**

Name of lecturer: **dr hab. Bohdan Padlyak, prof UZ**
dr Stefan Jerzyniak

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	III	Exam	
Class	30	2		Grade	

COURSE AIM:

The understanding of physical phenomena and processes in nature, definitions and description the fundamental physical quantities and laws, description of the fundamental interactions and fields, calculation and analysis of the main parameters of materials and devices, which are used in the modern technique.

ENTRY REQUIREMENTS:

Knowledge of physics and mathematics at the university courses, algebraic and geometric methods in physics including vector calculus and foundations of differential and integral calculations.

COURSE CONTENTS:

Lecture. Selected aspects of engineering mechanics, technical thermodynamics, instrumental optics, physics of materials, environmental physics, nuclear energy, and radiation protection. In particular:

– kinematics and dynamics of material point and rigid body;

– conservation laws in physics;

– oscillation and wave motions;

– elements of molecular physics and principles of thermodynamics;

– electrostatic and magnetic fields and their calculations;

– electromagnetic vibrations, electromagnetic waves and their applications;

– electrical properties of materials and their applications;

– magnetic phenomena, magnetic materials and their structure, characteristics and applications;

– geometrical and physical optics;

– optical properties (dispersion, diffraction, interference, and polarization of light) of materials and their applications;

– elements of atomic and nuclear physics;

– reactions of fission and fusion of the atomic nuclei, radioactivity, nuclear energy;

– foundations of environmental physics and radiation protection.

Class. Examples of calculation of the selected topics in classical mechanics of movements and forces – an analysis of additional technical examples. Samples of the calculation tasks with usage the principles of thermodynamics in terms of technical thermodynamics – heat engine, heat pump, cooler. Calculation and

quantitative analysis in the field of materials physics and instrumental optics. Discussion of examples of environmental hazards and radiation protection. Energy from fission and fusion of atomic nuclei – sample calculations.

TEACHING METHODS:

Conventional lectures, work with a book.
Conventional class.

LEARNING OUTCOMES:

Understands and is able to explain the course descriptions physical phenomena and processes using the language of mathematics can independently play the claims and rights and selected calculations (K1A_W03).

He knows the basic aspects of the design and operation of equipment and test equipment used in physics; he can refer the principle of operation of the medical device to the principles of operation of research equipment (K1A_W06).

You know the basic methods, techniques, equipment and materials used in medical physics, can indicate the reasons for the use of specific solutions in practice (K1A_W12).

Methodology used physical measurements and solves engineering tasks to solve practical problems, is able to plan, perform simple physical measurements, analyze measurement data, interpret, and present the results of measurement (K1A_U03).

Able to speak about issues of physical, technical, understandable, simple language (K1A_U06).

He is aware of their knowledge and skills, understands the need and knows the possibilities of continuous further training (second- and third-degree, postgraduate courses) – increasing professional and personal competences (K1A_K01).

Is aware of the social role of Graduate Technical Physics, and especially understands the need for formulating and providing the public with information and opinions on the achievements of physics and technology; shall endeavour to provide such information and opinions in a widely understandable (K1A_K05).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Class: attendance and class participation, credit for a passing grade on time.

Lecture: positive evaluation of the oral examination of the full range of material.

Before taking the exam a student must be credited with class.

Overall rating: arithmetic mean passes the exam and class.

STUDENT WORKLOAD:

- Participation in lectures: 30 h
- Participation in the class: 30 h
- Prepare for class: 30 h
- Exam preparation: 20 h
- Consultation and participation in exam: 5 h

Total: 115 h (5 ECTS).

Efforts associated with activities that require direct participation of teacher – 65 h (3 ECTS).

RECOMMENDED READING:

[1] D. Halliday, R. Resnick, J. Walter, *Podstawy fizyki*, PWN, Warszawa 2003.

[2] C. Bobrowski, *Fizyka – krótki kurs dla inżynierów*, WNT, Warszawa 2005.

[3] J. Masalski, M. Masalska, *Fizyka dla inżynierów*, t. 1 - 2. WNT, Warszawa 2005.

[4] E. Boeker, R. Van Grondelle, *Fizyka środowiska*, PWN, Warszawa 2002.

OPTIONAL READING:

[1] D. Halliday, R. Resnick, *Fizyka*, t. 1 - 2, PWN, Warszawa 1998.

[2] I. W. Sawieliew, *Wykłady z fizyki*, t. 1 - 3, PWN, Warszawa 2003.

[3] J. Orear, *Fizyka*, t. 1 - 2, WNT, Warszawa 1993.

PROGRAM PREPARATION:

Dr hab. Bogdan Padlyak, prof. UZ

MATHEMATICAL METHODS FOR ENGINEERS

Course code: **11.1-WF-FizTP-MMFdI**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **prof. dr hab. Andrzej Maciejewski**

Name of lecturer: **prof. dr hab. Andrzej Maciejewski**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	III	Grade	
Class	30	2		Grade	

COURSE AIM:

Acquainting the student with advanced mathematical methods necessary for understanding the contents of main study subjects.

ENTRY REQUIREMENTS:

Mathematical analysis I and II together with algebraic and geometric methods in physics.

COURSE CONTENTS:

- Elements of analytical geometry: planar and space curves, tangents and normals to planar curves, various parameterizations of of straight line, conics in Cartesian and polar coordinates, equations of plane in space, surfaces, quadrics and their classifications.
- Differential operators in curvilinear coordinates: planar and spatial Cartesian and curvilinear coordinates, curvilinear orthogonal coordinates, scalar and vector fields, differential operations on scalar and vector fields: gradient, divergence, rotation, Laplace operator in Cartesian coordinates; potential fields, divergence free fields and irrotational fields; gradient, divergence, rotation, Laplace operator in curvilinear orthogonal coordinates. Definition of tensor fields and algebraic operations on them.
- Elements of variational calculus: definition of functional and examples of them, weak and strong extrema, notion of variation of functional, necessary condition for existence of extremum of a functional, Eulera-Lagrange equations and their properties. Applications of variational calculus.
- Functions of complex variable: complex function of complex variable, limit of function, continuity of function, derivative of complex function, Cauchy-Riemanna conditions for the existence of the complex derivative, Cauchy integral formula, Taylor and Laurent series, singular points of a function, residue, calculation of integrals with the help of residue theory.
- Ordinary differential equations: first order differential equations: method of isoclines, finding solutions of various types of differential equations: separable, homogeneous, Bernoulli's and Riccati's equations, second order linear homogeneous and non-homogeneous differential equations with constant and variable coefficients, method of constant variations and method of undetermined coefficients.
- Partial differential equations of mathematical physics: vibrating string equation and d'Alembert method, membrane equation and Fourier method of variables separation, Laplace equation.

In class students solve problems illustrating the lecture material.

TEACHING METHODS:

Conventional lecture. Computational problems illustrating the lecture material together with its physical applications.

LEARNING OUTCOMES:

- Student knows and understands selected problems from analytical geometry, vector analysis, variational calculus, functions of complex variable and practical aspects of ordinary and partial differential equations of selected types. Student knows elementary terminology employed in these areas of science (K1A_W02, K1A_K01).

- Student knows and uses various parameterizations of planar and spatial curves, can write the straight line equation knowing various sets of given data, determines equations of tangents and normals to given planar curves, recognizes types of conics from their equations, rewrites conics equations from Cartesian to polar coordinates and vice versa, writes conics equations in coordinates frames with shifted origin (K1A_U02, K1A_W03).

- Student knows various types of curvilinear coordinates, can check whether the coordinates are orthogonal, determines Lame coefficients, knows how to determine gradient, divergence, rotation and Laplace operator in given orthogonal coordinates.; applies the properties of the Kronecker delta and Levi-Civita's symbol for derivation of various vectorial identities. Student can check if vector fields are divergence free or irrotational, determines scalar and vectorial potential for given vector fields; can transform scalar functions and vectorial fields from one to another coordinates system. (K1A_U02, K1A_W03).

- Student knows extremum condition for functionals and applies it for various problems of mathematics and physics (K1A_U02, K1A_W03).

- Student knows how to check if a complex function is differentiable and calculates its derivatives, knows parametrisation of the most important curves on complex plane and calculates integrals of complex functions, applies Cauchy integral formula to determine integrals of complex functions. Student knows definition of Taylor series and expands given function into Taylor series, understands the notion of holomorphic function, knows the singular points classification. Student knows the definitions of Laurent series and residue, calculates residua using different methods, applies residues to calculate integrals (K1A_U02).

- Student can solve basic classes of first and second order ordinary differential equations. Student knows fundamental partial differential equations: string, membrane and Laplace equations and knows simplest methods of solving them (K1A_W03, K1A_U02, K1A_U05).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: final test

Computational exercises: test

Before taking the final test the student must get a passing grade for the (laboratory) computational exercises.

The final grade is a weighted average of the test (60%) and the (laboratory) computational exercises (40%) grades.

STUDENT WORKLOAD:

- Participation in lectures: 15 weeks x 2 hours = 30 hours

- Preparation for lectures: 10 hours

- Participation in class: 15 x 2 = 30 hours

- Preparation for class: 20 hours

- Preparation for test: 10 hours

- Attending lecturers' office hours: 3 hours

- Preparation for exam: 20 hours

- Participation in exam: 2 hours

TOTAL: 125 hours, 5 ECTS.

Workload connected with lectures and classes requiring direct participation of the teacher amounts to 65 hours, this corresponds to 2,5 ECTS.

RECOMMENDED READING:

[1] R. Leitner, *Zarys matematyki wyższej*, część I, II i III, WNT, Warszawa 1998.

[2] D. McQuarrie, *Matematyka dla przyrodników i inżynierów,* T. 1, 2 i 3, PWN, Warszawa 2006.

[3] T. Jurlewicz, Z. Skoczylas, *Algebra i geometria analityczna*, Oficyna Wydawnicza GiS, Wrocław 2011.

[4] E. Karaśkiewicz, *Zarys teorii wektorów i tensorów*, PWN, Warszawa 1974.

[5] I. M. Gelfand, S. W. Fomin, *Rachunek wariacyjny*, PWN, Warszawa 1970.

[6] J. Długosz, *Funkcje zespolone*, Oficyna Wydawnicza GiS, Wrocław 2005.

[7] M. Gewert, Z. Skoczylas, *Równania różniczkowe zwyczajne*, Oficyna Wydawnicza GiS, Wrocław 2006.

[8] G. I. Zaporożec, Metody rozwiązywania zadań z analizy matematycznej, WNT, Warszawa 1976.

OPTIONAL READING:

[1] F. W. Byron, R. W. Fuller, *Metody matematyczne w fizyce klasycznej i kwantowej*, t. 1-2, PWN, Warszawa 1974.

[2] J. Bird, *Higher engineering mathematics*, Elsevier, Amsterdam 2006.

[3] B. A. Dubrovin, S. P. Novikov, A.T. Fomenko *Modern Geometry. Methods and Applications,* Part 1*,* Springer-Verlag, 1984.

PROGRAM PREPARATION:

Prof. dr Andrzej Maciejewski, prof. UZ

HUMAN ANATOMY AND PHYSIOLOGY II

Course code: **13.1-WF-FizTP-AiFC2**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Mariusz Kasprzak, prof. UZ**

Name of lecturer: **dr hab. Mariusz Kasprzak, prof. UZ**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					4
Lecture	45	3	III	Exam	

COURSE AIM:

Knowing the macroscopic organs (body parts, systems, organs) and microstructures (specific individual tissues and cells that build them) the human body. Linkage of organs to their function. Physiology of individual systems and the principles of their cooperation in the human body. Expanded range of knowledge about the anatomy and function of the musculoskeletal system and the senses.

ENTRY REQUIREMENTS:

Knowledge of human anatomy and physiology at the high school level

COURSE CONTENTS:

Epithelial tissue - structure, classification and distribution in the body. Glands - structure, classification and methods and regulation of secretion. Endocrine glands design, layout and operation. The effects of deficiency or excess of specific hormones.

Cardiovascular system - maintain a constant internal environment of the body by integrating the activities of other systems. Blood and lymph. Heart - structure and function. Construction of the arteries and veins. The network of capillaries and arterio - venous network of strange. Circulation large and small. The organization of the lymphatic system.

Gastrointestinal: gastrointestinal tract (episodes, building walls) and digestive glands (salivary glands, liver, pancreas, stomach and intestinal glands). Peritoneum. Control activities - innervation and blood supply to the organs of the digestive system. Obesity and its causes.

The respiratory system. Construction of the lung. Respiratory tract, larynx (pulmonary function and vocalization), bronchial tree, alveoli - gas exchange. Pleura, chest mechanics.

Urinary system - nefron, structure and function of the kidneys, the road discharging urine (ureter, bladder, urethra female and male).

The reproductive system - the sex cells, gametogenesis. Construction of male genitalia and female. Menstruation, pregnancy, menopause - symptoms, changes in the tissues and organs.

Homeostasis maintained at the cellular level, nervous and humoral.

TEACHING METHODS:

- Lecture and multimedia presentation

- Presentation and demonstration activities (boards and anatomical models), video teaching characterizing the physiological processes

LEARNING OUTCOMES:

Knowledge

K1A_W01 -Students knows the human anatomy

K1A_W02 – They understand the importance of a functional organ systems and their constituent units of morphological

K1A_W03, K1A_W04 - Lists and discusses the functional structure of the human

Skills

K1A_U01 - Recognizes the various human organs and indicates the correct position of the body

K1A_U02 - sees the human body as an integrated morphologically and physiologically band organ systems

K1A_U03 - Recognizes the diagrams of the major organ systems

K1A_U06 - Using the correct nomenclature of the anatomy and physiology in collaboration with the medical staff

Competencies

K1A_K01 - Able to work independently and in a team

K1A_K02 - Is interested in the complexity of the construction of the human body and recognizes the importance of healthy lifestyle

K1A_K03 - The constant development of medical science calls the interest of continuous expansion of knowledge.

K1A_K04 - Understand the need for ethical behavior in working with the material of human origin

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Tests in part after the discussion of individual organs. Written exam (test or a description of the process). 50% correct answers results in a satisfactory evaluation, 75% good, and over 85% very good

Final examination -the written-test (point rating above.)

STUDENT WORKLOAD:

- Participation in lectures: 45 hours.
- Preparation for the lecture and exam: 40 hours.
- Consultation: 3 hours.
- Participation in the exam: 2 hours.

A total of 90 hours, 4 ECTS.

Effort associated with activities that require direct participation of teachers: 50 hours., 2 ECTS.

RECOMMENDED READING:

[1] *Fizjologia człowieka z elementami fizjologii stosowanej i klinic*znej – red. W. Traczyk, A. Trzebski, PZWL, Warszawa 1990.

[2] W. Z. Traczyk, *Fizjologia człowieka w zarysie*, PZWL, 2005, wyd. VII.

[3] A. Michajlik, W. Ramotowski*, Anatomia i fizjologia człowieka*, PZWL, Warszawa 2001.

[4] A. Bochenek, M. Reicher*, Anatomia czł*owieka, PZWL, Warszawa 1993.

[5] E. Suder, S. Brużewicz*, Anatomia człowieka: podręcznik i atlas dla studentów licencjatów medycznych*, Wrocław; Górnicki Wydawnictwo Medyczne, 2004.

OPTIONAL READING:

[1] P. Dąbrowski, B. Kwiatkowska, J, Szczurowski, *Anatomia człowieka. Układ ruchu bierny* (*Systema motorium passivum*), Wyd. Uniwersytetu Wrocławskiego, 1995.

[2] R. Putz, R. Past, *Atlas anatomii człowieka*, Urban&Partner, Wrocław 1994.

[3] J. Bullock, J. Boyle, M. B. Wang, *Fizjologia*, Wydawnictwo medyczne Urban& Partner, 2004.

[4] B. K. Gołąb, *Anatomia czynnościowa ośrodkowego układu nerwowego*, Wydawnictwo Lekarskie PZWL, Warszawa 2004.

PROGRAM PREPARATION:

Dr hab. Mariusz Kasprzak, prof. UZ

ELEMENTS OF MEDICAL STATISTICS

Course code: **12.8-WF-FizTP-PStMe**

Type of course: **optional**

Language of instruction: **Polish**

Director of studies: **dr hab. Jarosław Piskorski, prof. UZ**

Name of lecturer: **dr hab. Jarosław Piskorski, prof. UZ**
dr Tomasz Masłowski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					
Lecture	30	2	III	Exam	4
Class	30	2		Grade	
Laboratory	30	2	IV	Grade	3

COURSE AIM:

To teach the students using selected methods of medical statistics to the extent necessary for the profession of medical physicist as well as supporting medical experts in scientific research.

ENTRY REQUIREMENTS:

Elements of calculus and linear algebra, elements of probability theory, the ability to use a spreadsheet.

COURSE CONTENTS:

- The area and aims of statistics, types of data, relationship between population and sample
- Introduction to probability theory, combinatorics.
- Introduction to probability theory: random variable, probability mass function, cumulative probability
- Parameters describing distributions and their estimators. Moments generating function
- Descriptive statistics and basic graphical techniques
- Introduction to statistical testing
- Continuous variable analysis – comparisons with the use of the *t* test
- Pearson correlation, introduction to linear regression
- Linear regression
- ANOVA
- Nonparametric statistics, Spearman correlation
- Wilcoxon and Kruskal-Wallis tests
- Tabular data analysis
- Logistic regression

- Introduction to survival analysis

TEACHING METHODS:

Lecture, computational exercises and computer based computations with the use of statistical software.

LEARNING OUTCOMES:

The student is able to define the area of interest of statistics (K1A_U06), is able to proces and transform medical data (K1A_W05, K1A_U03, K1A_U04), is able to describe a set with the use of descriptive statistics and graphical methods (K1A_U06), is able to correctly use basic statistical techniques and is able to quickly acquire new skills (K1A_U03, K1A_U07, K1A_K01, K1A_K04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Passing the final examination, positive grades on two tests and preparing a statistical project.

Before taking the examination the student needs to obtain passing grade in the computational exercises.

The final grade (after semester III): the arithmetic average of the examination grade and computational exercises grades.

STUDENT WORKLOAD:

- Participation in lectures: 30h
- Participation in computational exercises: 30h
- Participation in the laboratory exercises: 30h
- Preparation for the computational exercises: 20h
- Preparation for the laboratory exercises: 25h
- Examination: 3h
- Preparation for the examination: 20h
- Consultations: 7h

Total: 165 hours, 7 ECTS.

The burden of instructed activities is 100 hours which corresponds to 4 ECTS.

RECOMMENDED READING:

[1] J. Stanisz, *Przystępny kurs statystyki z zastosowaniem STATISTICA.P*L, tom1 i tom 2, StatSoft Polska 2006.

[2] R. Nowak, *Statystyka dla fizyków*, PWN, Warszawa 2002.

OPTIONAL READING:

[1] J. M. Bland, *An Introduction to Medical Statistics*, Oxford University Press, 2008.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

ANALYSIS OF MEDICAL DATA IN R*

Course code: **12.8-WF-FizTP-ADMPR**

Type of course: **optional**

Language of instruction: **Polish**

Director of studies: **dr hab. Jarosław Piskorski, prof. UZ**

Name of lecturer: **dr hab. Jarosław Piskorski, prof. UZ**
dr Tomasz Masłowski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					
Lecture	30	2	III	Exam	4
Class	30	2		Grade	
Laboratory	30	2	IV	Grade	3

COURSE AIM:

To teach the students data processing and performing statistical analyses necessary in the medical physicist's work as well as supporting medical experts in their scientific work. Teaching the students R programming at the intermediate level.

ENTRY REQUIREMENTS:

Ability to program in any programming language, proficiency in basic medical statistics

COURSE CONTENTS:

1) R language shell
2) RCommander package
3) Data processing in R, using foreign formats
4) Control instructions in R
5) Functions and namespaces
6) Basic analyses in R: t and Wilcoxon tests, Pearson and Spearman correlations, linear regression, ANOVA, tables, logistic regression, survival analysis
7) S3 and S4 classes
8) Elements of time series analysis in R
9) Image analysis in R
10) **ggplot**, **plyr** and **Sweave** packages
11) Other applications of R (bioinformatics, neuroscience)

TEACHING METHODS:

Lectures, computational exercises, laboratory exercises

LEARNING OUTCOMES:

The student is able to define the area of interest of statistics (K1A_U06), is able to proces and transform medical data (K1A_W05, K1A_U03, K1A_U04), is able to describe a set with the use of descriptive statistics and graphical methods in the R language (K1A_U06), is able to correctly use basic statistical techniques in the R language and is able to quickly acquire new skills (K1A_U03, K1A_U07, K1A_K01, K1A_K04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Final examination, completion of all laboratory exercises, preparation of a statistical project.

Before taking the examination the student needs to obtain passing grade in the computational exercises.

The final grade (after semester III): the arithmetic average of the examination grade and computational exercises grades.

STUDENT WORKLOAD:

- Participation in lectures: 30h
- Participation in computational exercises: 30h
- Participation in the laboratory exercises: 30h
- Preparation for the computational exercises: 20h
- Preparation for the laboratory exercises: 25h
- Examination: 3h
- Preparation for the examination: 20h
- Consultations: 7h

Total: 165 hours, 7 ECTS.

The burden of instructed activities is 100 hours which corresponds to 4 ECTS.

RECOMMENDED READING:

[1] Przemysław Biecek, *Przewodnik po pakiecie R*, Oficyna wydawnicza GIS, 2011.

[2] Przemysław Biecek, *Analiza danych z programem R*, Wydawnictwo Naukowe PWN, 2011.

OPTIONAL READING:

[1] Peter Daalgard, *Introductory Statistics with R*, Springer, 2004.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

ENGLISH AS A FOREIGN LANGUAGE

Course code: **09.0-WF-FizTP-JAng4**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **mgr Grażyna Czarkowska**

Name of lecturer: **mgr Grażyna Czarkowska**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Laboratory	30	2	IV	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to develop ability to compare objects, people, phenomena, to express necessity, prohibition and orders. The course provides an opportunity to learn the skill of writing formal letters, improve listening and reading comprehension. It helps students to further develop conversational skills, and gives basic knowledge of giving a presentation in English. It introduces vocabulary to describe atoms, helps students to get familiar with expressions used in thermodynamics and optics, as well as with medical instruments and life saving devices.

ENTRY REQUIREMENTS:

B1 of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will learn to:

- compare people, objects (4 hours)
- use modal verbs to express prohibition and orders (3 hours)
- write formal letters (4 hours)
- use verb forms – gerund, infinitive (3 hours)
- make a longer dialogue using structures and vocabulary learned earlier in the course – comparison, modals to express prohibition, etc. (2 hours)
- prepare and deliver a short presentation in English (4 hours)
- understand longer and more difficult texts (2 hours)
- develop listening comprehension of long conversations (2 hours)
- master vocabulary of thermodynamics and optics, name and describe functons of life saving devices (4 hours)
- understand simple specialist texts discussing problems of thermodynamics and optics, and describing medical instruments and life saving devices (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level B1+ of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- can compare people, objects, and phenomena
- can express prohibition, orders using modal verbs
- are able to write formal letters
- use verb forms (gerund, infinitive) according to the rules
- can have long dialogues using complex language structures and vocabularyused to describe functions of life saving devices
- are able to deliver a short presentation on a chosen topic in physics
- are familiar with vocabulary used in thermodynamics and optics
- can name medical instruments in English
- can deliver a short presentation in English
- can cooperate with members of a group, exchange information, and discuss problems

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, participating in class discussions, dialogues, delivering a presentation in English, getting information on different topics.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 1 hour

Private study:

- preparing a presentation – 3 hours
- getting ready for classes – 20 hours
- revising for tests – 6 hours

Total: 60 hours, 2 ECTS.

RECOMMENDED READING:

[1] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007.

[2] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007.

OPTIONAL READING:

[1] *FCE Use of English* by V. Evans.

[2] L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne.

[3] Internet articles.

[4] S. Hawking, *A Brief History of Time, The Universe In a Nutshell*, Bantam Books 2001.

PROGRAM PREPARATION:

Mgr Grażyna Czarkowska

FUNDAMENTALS OF PHYSICS IV – OPTICS, MODERN PHYSICS

Course code: **13.2-WF-FizTP-PF4OF**

Type of course: **compulsory**

Language of instruction: **polish**

Director of studies: **prof. dr hab. Andrzej Maciejewski**

Name of lecturer: **prof. dr hab. Andrzej Maciejewski**
dr Henryk Tygielski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					6
Lecture	30	2	IV	Exam	
Class	45	3		Grade	

COURSE AIM:

The aim of the course is acquainting students with basic laws of optics and elements of quantum physics necessary to understand and predict wave phenomena in optics and micro-world.

ENTRY REQUIREMENTS:

Mathematical methods in physics, Elements of physics I, II i III

COURSE CONTENTS:

LECTURE:

Electromagnetic waves in vacuum and material media.

Geometrical optics: reflection and refraction of light (Fermat's principle), mirrors, lenses, prisms; dispersion, aberrations and optical tools.

Wave optics: periodic wave motion, interference, diffraction and diffraction gratings, dispersion, absorption and dispersion of light, polarization of light.

Quantum nature of light: photoelectric and Compton effects, wave-particle duality.

Quantum nature of matter: atomic emission spectra, de Broglie's waves, diffraction of electrons, electron microscope. Quantum properties of matter: atom's models, energy quantization and Schrodinger equation, spin of electron and Pauli exclusion principle, multi-electron atoms, periodic table of elements, atom nuclei and elementary particles.

CLASS:

Solving chosen physical problems related to the lecture.

TEACHING METHODS:

Conventional lecture and demonstrations. Solving computational problems and discussing results.

LEARNING OUTCOMES:

Student has knowledge of classical optics and contemporary physics (K1A_W01).

Student understands and can explain physical phenomena from optics and atom physics (K1A_W03).

Student knows basic principles of construction and principles of operation of optical tools (K1A_W05).

Student can analyse theoretical problems from optics and draw reasonable conclusions (K1A_U02).

Student understands the necessity of inducing quantum notions to description of micro-world (K1A_K06).

Student can acquire on their own knowledge from optics and elements of contemporary physics (K1A_U07).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

LECTURE: Exam. The course credit is obtained by passing a final written exam composed of tasks of varying degrees of difficulty.

CLASS: A student is required to obtain at least the lowest passing grade from the written tests organized during class.

To be admitted to the exam a student must receive a credit for the class.

Final grade: weighted average of grades from exam (60%) and class (40%).

STUDENT WORKLOAD:

- Participation in lectures: 15 x 2 = 30 hours

- Participation in class: 15 x 3 = 45 hours

- Preparation for class: 45 hours

- Preparation for exam: 25 hours

- Participation in exam: 2 hours

- Attending lecturers' office hours: 3 hours

TOTAL: 150 hours, 6 ECTS

Workload connected with lectures and classes requiring direct participation of the teacher amounts to 80 hours. This corresponds to 3 ECTS.

RECOMMENDED READING:

[1] B. Jaworski, A. Dietlaf, *Kurs fizyki*, t. 3, *Procesy falowe. Optyka. Fizyka atomowa i jądrowa,* PWN, Warszawa 1984.

[2] I. W. Sawieliew, *Wykłady z fizyki,* t. 2, PWN, Warszawa 2002, (wyd. 3).

[3] J. R. Meyer-Arendt, *Wstęp do optyki,* PWN, Warszawa 1979.

[4] V. Acosta, C.L. Cowan, B.J. Graham, *Podstawy fizyki współczesnej,* PWN, Warszawa 1981.

[5] D. Halliday, R. Resnick, J. Walker, *Podstawy fizyki*, t. 4, t. 5, PWN, Warszawa 2003.

[6] J. Walker, *Podstawy fizyki. Zbiór zadań*, PWN, Warszawa 2005.

[7] David J. Griffiths, Podstawy elektrodynamiki, PWN, Warszawa 2005.

OPTIONAL READING: -

PROGRAM PREPARATION:

Prof. dr hab. Andrzej Maciejewski

PHYSICS LABORATORY I - OPTICS, MODERN PHYSICS

Course code: **13.2-WF-FizTP-LaFOF**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr Joanna Kalaga**

Name of lecturer: **dr Joanna Kalaga**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					4
Laboratory	45	3	IV	Grade	

COURSE AIM:

Teaching the basics of metrology and introduction into the basics of experimental physics.

ENTRY REQUIREMENTS:

- The knowledge of physics (optics, modern physics).
- The knowledge of metrology.

COURSE CONTENTS:

Terms and Physics Laboratory and safety and fire regulations.

List of exercises:

- The determination of the refractive index by measuring the apparent thickness.
- The determination of the refractive index of water by Abbe refractometer.
- The study of concentration of solution by saccharimeter SU-3.
- The determination of the constant of the diffraction grating using the laser.
- The determination of constant of the diffraction grating - method of the spectrometer.
- The determination of the refractive index by using a prism.
- The study of the photoelectric effect.
- The study of triode. Determination of the characteristics of triode.
- The study of the transistor.
- The determination of the electron work function.
- Study of background radiation.
- Examination of the distribution of pulses using a Geiger-Muller counter.

TEACHING METHODS:

Laboratory exercise.

LEARNING OUTCOMES:

- Student has a general knowledge of basic classical physics and methodology of physical measurement (K1A_W01).

- Student understands and explains physical phenomenon, knows statements and physical law's, can create a theoretical model and understands relation between experiment and theory (K1A_W03),
- Student knows and can use equipment physics laboratory and knows and can refer work rules of medical equipment to physics equipment (K1A_W06),
- Student knows the basic rules of safety and health at work, recognize the threat and knows how to prevent them (K1A_W07),
- Student is able to perform the analysis of experimental results and formulate on the basis of relevant proposals, including proposals for the applicability of these results in medical physics, and evaluation of solution (K1A_U02),
- Student knows the methodology of physical measurements, can plan and realize simples physical measurements, can analyse of experimental data and knows how to present results (K1A_U03),
- Student is conscious how necessary is the development of professional and personal skills. Student using different information sources (K1A_K04),
- Performs tasks in a way that ensures their own safety and the environment in this respect safety rules and regulations of the physical laboratory (K1A_K06).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification of background to the classes and the revision of the reports.

The grade obtained from every exercise consists of:

- grade from the preparation for classes 30%
- grade from the laboratory work 20%
- grade obtained from the report 50%

STUDENT WORKLOAD:

- Participation in classes: 45 hours
- Preparation to classes: 20 hours
- Preparation of the reports: 40 hours
- Participation in consultation: 2 hours

Total: 107 hours, 4 ECTS points.

Effort associated with activities that require direct participation of teachers: 47 hours, 2 ECTS.

RECOMMENDED READING:

[1] R. Resnick, D. Halliday, *Fizyka*, tom 2, Wydanie piętnaste, Wydawnictwo Naukowe PWN, Warszawa 2001.

[2] D. Halliday, R. Resnick, J. Walker, *Podstawy fizyki*, Wydawnictwo Naukowe PWN, Warszawa 2003.

[3] H. Szydłowski, *Pracownia fizyczna wspomagana komputerem*, Wydawnictwo Naukowe PWN, Warszawa 2003.

[4] H. Szydłowski, *Pracownia fizyczna*, Wydawnictwo Naukowe PWN, Warszawa 1994.

OPTIONAL READING:

[1] H. Szydłowski, *Wstęp do pracowni fizycznej*, Wydawnictwo Naukowe UAM, Poznań 1996.

[2] H. Szydłowski, *Niepewności w pomiarach. Międzynarodowe standardy w praktyce*, Wydawnictwo Naukowe UAM, Poznań 2001.

PROGRAM PREPARATION:

Dr Joanna Kalaga

ELECTRONICS AND ELECTROTECHNOLOGY - FUNDAMENTALS OF ELECTRONIC CIRCUITS

Course code: **06.2-WF-FizTP-PoUkE**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr inż. Robert Dąbrowski**

Name of lecturer: **dr inż. Robert Dąbrowski**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	IV	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

- To familiarize students with the basic concepts of electrical engineering,
- Mastering by the students the basic methods of analysis of electrical circuits in steady state
- Formation of basic skills in the use of basic equipment to measure voltage and power
- Familiarize students with the structure and properties of electronic components
- Shaping skills in testing of electronic components
- To familiarize students with the basics of building electronic circuits,
- Formation of skills in the use of electronic components and general-purpose operational amplifiers.

ENTRY REQUIREMENTS:

Calculus, Linear Algebra and Analytic Geometry, Physical principles of electrical engineering

COURSE CONTENTS:

Basic concepts: electric charge, current, potential, voltage, electric circuit, models of elements of electrical circuits: resistor, inductor, capacitor, ideal sources, real sources and controlled sources. Basic laws for electrical circuits: Ohm's law, Kirchhoff's law, the principle of superposition, reciprocity, Thevenin and Norton's theorems. The connections of Impedances: serial, parallel, star-delta and dividers.

Methods of circuits analysis. Sinusoidal alternating current circuits. Symbolic Method, complex impedance, vector diagrams, active power and apparent power, power balance, adjusting the receiver to the source, resonance.

Non-linear elements: diodes, optoelectronic components, bipolar transistors, field effect transistors and MOS - parametric models (acceptable parameters and characteristic), equivalent diagrams, parasitic parameters , current-voltage characteristics. Relays and reed switches.

The use of electronic components for simple electronic circuits: divider, filter, system status display device using LEDs, galvanic separation using optocouplers, transistor amplifiers. General-purpose operational amplifiers and their applications.

TEACHING METHODS:

Lecture: Working with source document, case study, discussion

Laboratory: Work with a source document, computer simulation, laboratory exercise

LEARNING OUTCOMES:

The student knows the basic concepts and principles of the basics of electrical engineering (K1A_W01, K1A_W03).

He can measure voltage, current and active power and identify the basic parameters of the circuit (K1A_W06, K1A_U03, K1A_U04).

He is able to design, run, and test simple electronic circuits using electronic components and operational amplifiers (K1A_W05, K1A_W02, K1A_U03, K1A_U01, K1A_U02). Understand and analyze the performance of electronic circuits using electronic components and operational amplifiers (K1A_W06, K1A_W03, K1A_U01). He is aware of his knowledge and skills, understands the necessity of lifelong learning (K1A_K01). It has a sense of responsibility for their own work and the willingness to comply with the principles of team work (K1A_K03).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Methods of verification:

- Lecture: tests, exam in writing.
- Laboratory: report.

Lecture - positive assessment of written tests and a positive result of the exam .

Laboratory - good ratings from the reports of all laboratory exercises .

The components of the final grade = lecture: 50 % + lab: 50%

Before taking the exam the student must have positive grade with exercise.

STUDENT WORKLOAD:

- Participation in lectures: 30h
- Participation in laboratory exercises: 30h
- Preparing for laboratory classes: 15h
- Getting acquainted with the indicated literature: 10h
- Preparation of the report / report: 15h
- Execution of the tasks assigned by the teacher: 10h
- Preparation for the exam = 15 hours. Participation in the exam: 2h

Total: 127 hours, 5 ECTS.

Workload associated with activities that require direct participation of teacher: 62 hours, 2,5 ECTS.

RECOMMENDED READING:

[1] Z. Czchowska, M. Pasko, *Wykłady z elektrotechniki teoretycznej*, Cz. I *Działy podstawowe*. Cz. II *Prądy sinusoidalnie zmienne*, Wydawnictwo Politechniki Śląskiej, Gliwice 1998.
[2] R. Kłosiński, L. Chełchowska, D. Chojnicki, Z. Siwczyńska, E. Rożnowski, *Instrukcje do ćwiczeń laboratoryjnych*, materiały niepublikowane, Zielona Góra 1988 - 2004.
[3] P. Horowitz, W. Hill, *Sztuka elektroniki*, Wydawnictwa Komunikacji i Łączności, Wydanie 7, Warszawa 2003.
[4] K. Waczyński, *Przyrządy półprzewodnikowe - podstawy działania diod i tranzystorów*, skrypt 2022, Wydawnictwo Politechniki Śląskiej, Gliwice 1997.
[5] K. Waczyński, E. Wróbel, *Przyrządy półprzewodnikowe – zadania*, Skrypt nr 2083, Wydawnictwo Politechniki Śląskiej, Gliwice 1998.

OPTIONAL READING:

[1] R. Kurdzie, *Podstawy elektrotechniki*, WNT, Warszawa 1973.
[2] A. Chwalebna, B. Moeschke, G. Płoszyński, *Elektronika*, Wydawnictwa Szkolne i Pedagogiczne, Wydanie 6, Warszawa 1998.
[3] J. Hennel, *Podstawy elektroniki półprzewodnikowej*, WNT, Warszawa 1995.
[4] Z. Kleszczewski, Podstawy fizyczne elektroniki ciała stałego, Wydawnictwo Politechniki Śląskiej, Gliwice 1997.

PROGRAM PREPARATION:

Dr inż. Robert Dąbrowski

BIOPHYSICS

Course code: **13.0-WF-FizTP-Biofi**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Jarosław Piskorski, prof. UZ**

Name of lecturer: **dr hab. Jarosław Piskorski, prof. UZ**
dr Joanna Kalaga

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	IV	Grade	
Class	30	2		Grade	

COURSE AIM:

The aim of the course is to teach the foundations of biophysics to the extent which is both necessary and useful in biomedical engineering

ENTRY REQUIREMENTS:

Foundations of Physics course for engineers

COURSE CONTENTS:

1) Static forces: equilibrium considerations for the human body, skeletal muscles, levers, the elbow, the hip,

2) Friction: standing and moving on an incline, friction at joints,

3) Translational motion: jump – maximum standing and running jump and vault poling, energy considerations,

4) Angular motion: running: running on a curved track, pendulum and walking, speed of running, model of walking and running,

5) Elasticity and strength of materials: longitudinal stretch and compression, spring, bone fracture: energy and impulse force considerations, injuries in car accidents, osteoarthritis and exercise,

6) Fluids: force and pressure in fluids, Pascal's principle, hydrostatic skeleton, Archimedes' principle, power required for floating, surface tension,

7) Motion of fluids: Bernouli's equation, viscosity and Poiseuille law, turbulent flow, circulation of the blood, blood pressure, control of blood flow, turbulence in the blood, arteriosclerosis and blood flow, power produced by the heart, blood pressure measurement,

8) Heat and Kinetic Energy: Heat and hotness, kinetic theory of matter, basic definitions, transfer of heat, transfer of molecules by diffusion, diffusion through membranes, the respiratory system, surfactants and breathing, diffusion and contact lenses,

9) Thermodynamics: first and second laws of thermodynamics, thermodynamics of living systems, information and the second law,

10) Heat and life: energy requirements of people, energy from food, regulation of body temperature, control of skin temperature, evaporation, resistance to cold,

11) Electricity: nervous system, electrical potential in the axon, action potential, synaptic transmission, electricity in plants, electricity in the bones, electric fish, heart as an electric device,

12) Optics: vision, nature of light, structure of the eye, accommodation, lens system of the eye, resolving power of the eye, corrective lenses,

13) Atomic physics: the atom, spectroscopy, quantum mechanics, electron microscope, X-rays, Computed Tomography, lasers,

14) Nuclear physics: the nucleus, magnetic resonance imaging, radiation therapy, food preservation by radiation, isotopic tracers, laws of physics and life.

TEACHING METHODS:

Lectures, computational exercises

LEARNING OUTCOMES:

The student is able to describe the physical bases of the functioning of living organisms (K1A_W03, K1A_W04, K1A_W06), K_W10), is able to explain the functioning of the basic systems of the human body in terms of physics (K1A_W03, K1A_W03, K1A_U05),. The student is aware of the limitations of the human and animal bodies following from the laws of physics (K1A_W04, K1A_W05, K1A_W06, K1A_W07). The student is able to apply the knowledge and skills of a physicist to solving biological and medical problems (K1A_U02, K1A_U05).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: final tests

Computational exercises: passing two tests

Before taking the final test the student must get a passing grade for the computational exercises.

The final grade: the arithmetic average of the lecture grade and the computational exercises grade**.**

STUDENT WORKLOAD:

- Participation in the lectures: 30h
- Preparation for the lectures: 15h
- Participation in the laboratory: 30h
- Preparation for the laboratory: 30h
- Consultations: 15h

Total: 120 hours, 5 ECTS.

The workload of instructed activities is 75 hours which corresponds to 3 ECTS.

RECOMMENDED READING:

[1] F. Jaroszyk, *Biofizyka*, Wydawnictwo Lekarskie PZWL, Poznań 2008.

OPTIONAL READING:

[1] P. Davidovits, *Physics in Biology and Medicine*, Academic Press, New York 2008.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

MEDICAL INSTRUMENTS, IMAGING AND DIAGNOSTICS I

Course code: **12.8-WF-FizTP-IODM1**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Jarosław Piskorski, prof. UZ**

Name of lecturer: **dr hab. Jarosław Piskorski, prof. UZ**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	IV	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

Teaching the student the rules of operation and usage of the most important medical equipment both therapeutic and diagnostic used in contemporary medicine as well as the physical and technical foundations of its operation.

ENTRY REQUIREMENTS:

Foundations of physics course, introduction to biology and medical biology, basic anatomy and physiology course

COURSE CONTENTS:

- Fluoroscopy – rules of operation and equipment usage
- Fluoroscopy – projections and fluoroscopic image
- Computed tomography – rules of operation and equipment usage
- Computed Tomography – image analysis and interpretation
- Computed Tomography – clinical applications in the imaging of various body parts
- Planar scintygraphy SPECT i PET/CT – rules of operation and equipment usage
- Planar scintygraphy, clinical applications
- Magnetic resonance imaging – rules of operation and equipment usage
- Magnetic resonance imaging – clinical applications, indications and contradications, comparison with CT
- Cardiac stimulators, ICD, CRT – rules of operation and equipment usage, measurements at the electrophysiological table
- Electrophysiological mapping – rules of operation and equipment usage
- Electrophysiological mapping – CARTO imaging
- FFR measurement – rules of operation and equipment usage

TEACHING METHODS:

Lectures, laboratory exercises (in the medical physics laboratory), calculational exercises, observations and exercises at the District Hospital in Zielona Góra, project.

LEARNING OUTCOMES:

The student is able to explain the principles of operation of the basic medical devices on the grounds of physics and medical biology, anatomy and physiology (K1A_W03, K1A_W04, K1A_W06, K1A_W11, K1A_W12), he or she is able to use or knows the rules of usage of medical devices (K1A_W05, K1A_W06, K1A_W10), he or she is able to carry out the basic calculations necessary to understand the results of diagnostic measurements (K1A_W03, K1A_W05, K1A_W06, K1A_W11, K1A_U02), the students knows the safety rules in using medical equipment, knows and understand safety rules used in hospitals, including the epidemiological protection (K1A_W07, K1A_W10, K1A_W11), the student can understand and learn how to use medical equipment on his or her own (K1A_U07, K1A_U08, K1A_U10, K1A_K04), the student can work in a group and conform to the requirements of distribution of responsibilities and tasks during measurements, diagnostics and therapy (K1A_K02).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Passing the final examination, carrying out all the laboratory exercises and writing all the reports as well as active participation in the classes.

Before taking the examination the student needs to obtain passing grade in the laboratory exercises.

The final grade: the arithmetic average of the examination grade and laboratory exercises grades

STUDENT WORKLOAD:

- Taking part in the lecture: 30h
- Preparation for the examination: 20h
- Taking part in the laboratory exercises: 30h
- Preparation for the laboratory exercises: 30h
- Consultations: 5h
- Examination: 2h

Total: 117 hours, 5 ECTS.

The burden of instructed activities is 67 hours which corresponds to 3 ECTS.

RECOMMENDED READING:

[1] F. Jaroszyk, *Biofizyka,* Wydawnictwo Lekarskie PZWL, Poznań, 2008.

OPTIONAL READING:

[1] Davidovits, *Physics in Biology and Medicine*, Academic Press, New York, 2008.

[2] John G. Webster, *Medical Instrumentation Application and Design*, Wiley, New York 2009.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

ENGLISH AS A FOREIGN LANGUAGE

Course code: **09.0-WF-FizTP-JAng5**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **mgr Grażyna Czarkowska**

Name of lecturer: **mgr Grażyna Czarkowska**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Laboratory	30	2	V	Grade	

COURSE AIM:

The course aims to enable students to improve speaking, reading and writing skills, as well as listening comprehension in English. It will help the students to develop their ability to apply language functions to effective communication in everyday life. The course also aims to develop ability to describe hypothetical situations, express probability, give advice and use Passive Voice properly. The course provides an opportunity to learn the skill of writing formal letters, improve listening and reading comprehension. It helps students to further develop conversational skills, and ability to deliver a presentation in English.

The course helps students to develop vocabulary from the following topics – electricity, magnetism, physics in nuclear medicine, elements of medical rescue.

ENTRY REQUIREMENTS:

B1+ of the Common European Framework of Reference for Languages specified by the Council of Europe.

COURSE CONTENTS:

During the course students will learn to:

- describe hypothetical situations, use conditional sentences referring to present, future and past (6 hours)
- use clauses of time introduced by *when, as soon as, till, before, after* (2 hours)
- use modal verbs to express probability (2 hours)
- understand and form correct sentences in Passive Voice (4 hours)
- understand long and difficult non-specialist texts describing hypothetical situations, as well as discussing social issues (4 hours)
- prepare and deliver a presentation in English using language structures studied during the course (6 hours)
- develop listening skills (2 hours)
- understand and use specialist vocabulary – electricity, magnetism, physics in nuclear medicine, elements of medical rescue (2 hours)
- analyse and understand specialist texts (2 hours)

TEACHING METHODS:

The course focuses on communication activities in functional and situational context. It encourages students to speak with fluency and develop the four skills of reading, writing, listening and speaking by means of group and pair work, discussion, presentation, oral and written exercises.

LEARNING OUTCOMES:

Achieving language skills and competence on level B2 of the Common European Framework of Reference for Languages.

Upon successful completion of the course, the students:

- can describe hypothetical situations with the use of adequate language structures
- use modal verbs to express probability and give advice
- use with understanding Passive Voice
- can prepare and deliver a presentation on a topic concerning a branch of physics
- are familiar with and can use specialist vocabulary from the following topics – electricity, magnetism, physics in nuclear medicine, elements of medical rescue
- understand specialist texts
- can cooperate with members of a group, exchange information
- can discuss problems concerning technical physics

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Classes – grade: a condition for receiving a credit are positive marks for tests, participating in class discussions, dialogues, delivering a presentation in English, getting information on different topics.

STUDENT WORKLOAD:

Contact time:

- classes – 30 hours
- consultation – 1 hour

Private study:

- preparing a presentation – 3 hours
- getting ready for classes – 20 hours
- revising for tests – 6 hours

Total: 60 hours, 2 ECTS.

RECOMMENDED READING:

[1] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Student's Book,* Oxford University Press 2007.

[2] C. Oxenden, V. Latham-Koenig, P. Seligson, *New English File Workbook,* Oxford University Press 2007.

OPTIONAL READING:

[1] *FCE Use of English* by V. Evans.

[2] L. Szkutnik, *Materiały do czytania – Mathematics, Physics, Chemistry,* Wydawnictwa Szkolne i Pedagogiczne.

[3] Internet articles.

[4] J. Pasternak-Winiarska, *English in Mathematics*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.

[5] S. Hawking, *A Brief History of Time, The Universe In a Nutshell*, Bantam Books 2001.

PROGRAM PREPARATION:

Mgr Grażyna Czarkowska

INTELLECTUAL PROPERTY PROTECTION, OCCUPATIONAL SAFETY, ERGONOMICS

Course code: **16.0-WF-FizTP-OWIBP**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **prof. dr hab. inż. Edward Kowal**

Name of lecturer: **prof. dr hab. inż. Edward Kowal**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					1
Lecture	15	1	V	Pass/Fail	

COURSE AIM:

The practical application of the legal principles of intellectual property. Knowledge of the basic factors influencing the ergonomic, safe and healthy working conditions - the impact of their influence.

PREREQUISITES: -

SUBJECT AREA OF THE COURSE:

The practical application of the legal principles of intellectual property. Knowledge of the basic factors influencing the ergonomic, safe and healthy working conditions - the impact of their influence. The importance of the rights and standards in the art. The basic instrument for the protection of intellectual property rights: patents, copyrights, trademarks. Legal regulations on intellectual property rights. The provisions on the protection of inventions, industrial designs and trademarks, applied art objects and other works of authorship (studies, publications, culture). Legal basis for conservation work. Management systems working conditions and occupational hazards. The science behind ergonomics including anthropometric requirements, industrial hazard and its effects, work organization, human system - a technical object.

TEACHING METHODS:

Informative lecture, lecture and a seminar problem, activating methods - method of cases.

EDUCATION OUTCOMES:

- The student has a basic knowledge of the man, especially as a social entity, engineered structures and principles of their functioning and operating in these structures, in the field of health promotion.
- The student knows the basic rules of safety and health at work, recognize the threat and selects the appropriate measures to prevent them (K1A_W06).
- The student has a basic knowledge regarding the legal and ethical issues in research and teaching especially in the field of intellectual achievements (K1A_W07).
- Student correctly identifies and resolves dilemmas associated with the pursuit of health and safety inspector's

work.
- The student has a basic knowledge of copyright, intellectual property protection, the use of appropriate licenses and rights to scientific, personal and commercial (K1A_W08, K1A_W07).
- The student can independently acquire knowledge and develop skills using a variety of sources (polish language and foreign language) and modern technology (K1A_U07, K1A_U10).
- The student is aware of the importance of behavior in a professional, ethical values and respect for diversity of opinion (K1A_K03).

EDUCATION OUTCOMES AND CREDITS REQUIREMENTS VERIFICATION:

The presence and activity in the classes, the ability to use relevant legislation.

STUDENT WORKLOAD:

Hours	Student work	ECTS
15	Participation in classes	0,5
5	Participate in consultations	0,2
10	Individual work and preparations for classes	0,3
30		**1**

RECOMMENDED READING:

[1] Dyrektywa ramowa 89/391/EWG.

[2] E. Kowal, *Ekonomiczno społeczne aspekty ergonomii*, PWN, Warszawa 2004.

[3] Kodeks Pracy.

[4] Rozporządzenie MIPS z 26 września 1997 W sprawie ogólnych przepisów bhp wraz ze zmianami.

[5] J. Lozański, *Własność przemysłowa* i *intelektualna w Unii Europejskie*j, Warszawa- Poznań 2005.

OPTIONAL READING: -

PROGRAM PREPARATION:

Prof. dr inż. Edward Kowal

ENGINEERING GRAPHICS

Course code: **11.3-WF-FizTP-GrInż**

Type of course: **compulsory**

Language of instruction: **Polish**

Syllabus preparation: **dr Marcin Kośmider**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	V	Grade	
Laboratory	30	2		Grade	

COURSE AIM:

The aim of the course is to familiarize students with the basics of engineering graphics, learning the principles of mapping and sizing, read with CAD systems and creating graphics for technical and bid documentation.

ENTRY REQUIREMENTS:

Computer literacy

COURSE CONTENTS:

- fundamentals of axonometric drawing
- design records
- mapping and dimensioning
- projection
- reading assembly drawings
- overview of CAD/CAM software
- CAD / CAM systems as a tool to support the creation of technical documentation
- Computer graphics in the creation of technical and bid documentation.

TEACHING METHODS:

Lectures, laboratory, project, presentation

LEARNING OUTCOMES:

- student is able to read technical documentation
  (K1A_W06, K1A_W09, K1A_W11, K1A_K02, K1A_K06)
- student can write technical documentation
  (K1A_W06, K1A_W11, K1A_U08, K1A_K02, K1A_K06)
- student is able to read and write dimensioning
  (K1A_W06, K1A_K02, K1A_K06)

- student is able to use CAD/CAM software for the creation of technical documentation (K1A_W05, K1A_W09)
- student can use computer graphics tools for creating technical and bid documentation. (K1A_W05, K1A_U04, K1A_U04)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: test

Laboratory: test (40%), project (60%)

STUDENT WORKLOAD:

Lectures: 30 h

Laboratories: 30 h

Preparing for laboratories: 30 h

Project preparation: 10 h

Preparation for exam: 10 h

Consultation: 5 h

Exam: 2 h

Sum: 117 h, 5 ECTS.

RECOMMENDED READING:

[1] H. Koczyk, *Geometria wykreślna*, PWN, Warszawa 1995.

[2] J. Bajkowski, *Podstawy zapisu konstrukcji*, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005.

[3] Danuta i Janusz Smołucha, K. Skalski, *Grafika komputerowa (Modelowanie geometryczne - laboratorium),* Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.

OPTIONAL READING: -

PROGRAM PREPARATION:

Dr Marcin Kośmider

ELEMENTS OF QUANTUM PHYSICS

Course code: **13.2-WF-FizTP-PFiKw**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	30	2	V	Exam	
Class	30	2		Grade	

COURSE AIM:

The aim of the course is to provide the students of engineering with the interpretation of quantum phenomena, the basics of mathematical description of these phenomena.

ENTRY REQUIREMENTS:

General physics, Mathematical analysis methods.

COURSE CONTENTS:

1. The history of quantum mechanics.
2. The Schrödinger equation - the wave concept of quantum mechanics (probability density, the wave function, the eigenvalues, the particle in potential well, harmonic oscillator, the evolution of wave packet, the uncertainty principle)
3. Operators in quantum mechanics.
4. Issues in the one-dimensional quantum mechanics.
5. Hydrogen.
6. Approximate methods of quantum mechanics (perturbation theory, variational methods).
7. Association of spin with statistics, fermions, bosons.
8. The methods of modern quantum physics.

TEACHING METHODS:

Methods of education have two forms of lectures and excersises. Each lecture is presented with an indication of the theory to the calculation of the selected examples at classes. Tutorials are practical, detailed issues are carried out for the harmonic oscillator and one-dimensional problems.

LEARNING OUTCOMES:

Students have a basic knowledge of the specific quantum methods. General knowledge (K1A_W01, K1A_W03) is supported by a detailed accounting skill for simple models and the ability to explain phenomena (K1A_U01, K1A_U02).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The course ends with an exam grade. Examination is a written test of theoretical knowledge and practical skills in accounting. The effects of exercise training are reviewed by partial reviews on completed tasks, evaluation of written tests and assessment of accounting skills and understanding of selected topics of condensed matter physics.
Overall rating: arithmetic mean score of the exam and exercises.

STUDENT WORKLOAD:

- Participation in lectures: 30 hours
- Participation in exercises: 30 hours
- Preparation for the exercises: 30 hours
- Consulting for the lecturees and exercises: 5 hours
- Preparation for the completion of the lecture: 25 hours

TOTAL: 120 hours, 5 ECTS.

Contact hours: 65 hours, 2.5 ECTS.

RECOMMENDED READING:

[1] Leonard I. Schiff, *Qunatum Mechanics*, McGRAW-HILLBook Company (1968).

[2] Dawid A.B. Miller, *Quantum Mechanics for Scientists and Engineers*, Cambridge University Press (2008).

OPTIONAL READING:

[1] Internet

PROGRAM PREPARATION:

Dr hab. Mirosław Dudek, prof. UZ

BIOPHYSICS AND BIOCHEMISTRY LABORATORY

Course code: **13.6-WF-FizTP-PrBiB**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher directing the laboratory exercises**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					3
Laboratory	30	2	V	Grade	

COURSE AIM:

Teaching the students the basic biophysical and biochemical phenomena and reactions as well as their applications in medicine.

ENTRY REQUIREMENTS:

Basic knowledge of mathematical analysis, physics laboratory I.

COURSE CONTENTS:

- Electrocardiography – ECG recordings, measurement of the intervals and segments, electrical axis of the heart and orthogonal coordinates.
- Phosphate buffer capacity.
- Haemodynamics – heart rhythm, blood pressure, baroreflex and Valsalva maneouver.
- Alkacymetric titrate of Coca-Cola.
- Laser – coherence and beam power – medical usage.
- Sight deffects corrections, detecting the curvature of the lenses, correction of the focal length.
- Chemistry of smell – esther synthesis.
- Ultrasonography: ultrasound absorption and the speed in liquids.
- Fatty acids hydrolysis.

TEACHING METHODS:

Laboratory exercises

LEARNING OUTCOMES:

The student can perform the systolic and diastolic blood pressure measurement, heart rhythm, is able to attach the ECG and take the measurements as well as measuring the characteristics of the electrocardiogram (K1A_W10, K1A_W12, K1A_U03, K1A_U05), he or she can use the basic chemical equipment, he or she knows the usage of ultrasound and lasers in medicine (K1A_U03, K1A_U05), the student knows how to prepare a written report on the performed experiment/exercise (K1A_U8, K1A_U09).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Positive grade on all the assignments

STUDENT WORKLOAD:

- Taking part in the laboratory: 30h
- Preparation for the laboratory: 35h
- Consultations: 5h

Total: 70 hours, 3 ECTS.

The workload requiring direct participation of the instructor: 35 hours, 1,5 ECTS.

RECOMMENDED READING:

[1] F. Jaroszyk, *Biofizyka*, Wydawnictwo Lekarskie WZKL, 2008.

[2] J. M. Berg, *Biochemia*, PWN, 2009.

OPTIONAL READING:

[1] A. K. Honsew, *Biophysical laboratory*, Nawhab College Press, 2003.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

MEDICAL INSTRUMENTS, IMAGING AND DIAGNOSTICS II

Course code: **12.8-WF-FizTP-IODM2**

Type of course: **Compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Jarosław Piskorski, prof. UZ**

Name of lecturer: **dr hab. Jarosław Piskorski, prof. UZ**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					
Lecture	30	2	V	Exam	7
Laboratory	15	1		Grade	
Project	15	1		Grade	

COURSE AIM:

To familarize the student with the basic therapeutic and diagnostic instruments used in contemporary clinical practice as well as with the physical and technical foundations of thier operation

ENTRY REQUIREMENTS:

Sound knowledge of the foundations of physics (excluding nuclear physics and elementary particles physics), the knowledge of elements of mathematical methods of physics, preparation in the first physical laboratory, good knowledge of the anatomy and physiology of humans.

COURSE CONTENTS:

-Anthropometric measurements
-The methods of measuring blood pressure and pulse
- Pulse oxymetry – principles of operation, usage and monitoring
- Electric action of the heart, ECG – construction, usage, monitoring, standard ECG and orthogonal leads (2 lectures)
- EEG – principles of operation, usage and monitoring
- Bioimpedance, establishing the composition of the body (2 lectures) – principles of operation, usage and monitoring
- Breath monitoring, composition of the exhaled air
- Construction of the eye, instruments used in ophthalmology (2 lectures)
- Ultrasonography: principles of operation, types of USG images
- Application of ultrasonography to image processes in various organs of the body (2 lectures)
- The organ of hearing and the methods of its examination
- Electromyography, principles of operation

TEACHING METHODS:

Lectures, laboratories (in the medical physics lab), computational exercises, observations and participatory exercises in Zielona Góra District Hospital.

LEARNING OUTCOMES:

The student is able to explain the principles of operation of the basic medical devices on the grounds of physics and medical biology, anatomy and physiology (K1A_W03, K1A_W04, K1A_W06, K1A_W11, K1A_W12), he or she is able to use or knows the rules of usage of medical devices (K1A_W05, K1A_W06, K1A_W10), he or she is able to carry out the basic calculations necessary to understand the results of diagnostic measurements (K1A_W03, K1A_W05, K1A_W06, K1A_W11, K1A_U02), the students knows the safety rules in using medical equipment, knows and understand safety rules used in hospitals, including the epidemiological protection (K1A_W07, K1A_W10, K1A_W11), the student can understand and learn how to use medical equipment on his or her own (K1A_U07, K1A_U08, K1A_U10, K1A_K04), the student can work in a group and conform to the requirements of distribution of responsibilities and tasks during measurements, diagnostics and therapy (K1A_K02).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Lecture: passing grade in the examination

Laboratory: the arithmetic average of the grades obtained for all the exercises and the test

Project: grade for the preparation of the project.

Before taking the examination the student needs to achieve a passing grade in the laboratory exercises.

Final grade: weighted average of the examination grade (40%) laboratory exercises (40%) and the project (20%).

STUDENT WORKLOAD:

- Taking part in the lecture: 30h
- Preparation for the examination: 25h
- Examination: 2h
- Participation in the laboratory exercises: 15h
- Preparation for the laboratory exercises: 20h
- Participation in the project: 15h
- Preparation of the programming project: 25h
- Consultations: 10h

Total: 142 hours, 7 ECTS.

The workload requiring direct participation of the instructor: 72 hours, 3,5 ECTS.

RECOMMENDED READING:

[1] F. Jaroszyk, *Biofizyka*, Wydawnictwo Lekarskie PZWL, Poznań 2008.

OPTIONAL READING:

[1] P. Davidovits, *Physics in Biology and Medicine*, Academic Press, New York 2008.

[2] John G. Webster, *Medical Instrumentation Application and Design*, Wiley, New York 2009.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

SIGNAL ANALYSIS

Course code: **13.2-WF-FizT-AnaSy**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					9
Lecture	30	2	V	Exam	
Laboratory	30	2		Grade	
Project	30	2	VI	Grade	

COURSE AIM:

Teaching the students the elements of signal analysis necessary in the work of the medical physicist, including digital image analysis.

ENTRY REQUIREMENTS:

Introductory physics course, linear algebra and geometry undergraduate course, calculus undergraduate course.

COURSE CONTENTS:

- Continuous and discrete signals
- Analog to digital conversion
- Statistical signal analysis
- Linear and time-invariant signals
- Fourier representation of periodic signals
- Filtering, aliasing and leakage
- Continuous Fourier Transform
- Discrete Fourier Transform
- Fast Fourier Transform
- The signal characteristics in the time domain and frequency domain, including spatial distribution as equivalent of time-variable
- Sampling and signal reconstruction
- Laplace and Z transforms
- Linear systems with feedback
- Introduction to image analysis, image as signal
- Fourier and correlational image analysis

TEACHING METHODS:

Lectures, computational exercises, computer laboratory

LEARNING OUTCOMES:

The student is able to define the area of signal analysis (K1A_W05, K1A_W06), and knows the basic terminology (K1A_W05, K1A_W06), the student can perform the basic analyses in the time and frequency domains (K1A_U03, K1A_U04, K1A_W05, K1A_W06), he or she can set filters in medical equipment in order to reduce noise (e.g. the notch filter at 50Hz) (K1A_W12), the student can implement the basic methods of image analysis (K1A_U03, K1A_U04).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Passing the final examination, carrying out all the laboratory exercises and writing all the reports as well as active participation in the classes.

Before taking the examination the student needs to obtain passing grade in the laboratory exercises.

The final grade (after semester V): the arithmetic average of the examination grade and laboratory exercises grades.

STUDENT WORKLOAD:

- Taking part in the lecture: 30h
- Taking part in the laboratory exercises: 30h
- Preparation for the laboratory exercises: 30h
- Preparation for the examination: 20h
- Consultations: 15h
- Examination: 3h
- Participation in the project: 30h
- Project preparation: 45h

Total: 203h, 9 ECTS.

The workload requiring direct participation of the instructor: 108h, 5 ECTS.

RECOMMENDED READING:

[1] T. P. Zieliński, *Cyfrowe przetwarzanie sygnału. Od teorii do zastosowań*, WKŁ, 2009.

OPTIONAL READING:

[1] A. V. Openheim, A. S. Willski, S. H. Nawab, *Signals and Systems*, Prentice Hall 2006.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

RADIATION PROTECTION

Course code: **13.2-WF-FizTP-OchRa**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Lecture	30	2	V	Grade	

COURSE AIM:

To teach the students fundamentals of radiological protection to the extent necessary for the medical staff working in ionizing radiation.

ENTRY REQUIREMENTS:

Foundations of physics course, introduction to biology and medical biology

COURSE CONTENTS:

- The influence of ionizing radiation on live organisms.
- Basic radiological quantities, units, converting between units.
- Dosimetric instruments and their calibration.
- Examplex of basic usage of nuclear techniques and the associated risk.
- Calculation of radiation doses acceptable in specific situations.
- Basic rules of radiological protection.
- Atomic law.
- Certification for work in ionizing radiation.
- Guidelines for working with open and closed sources of radiation.
- Transportation and storage of radioactive materials.
- Radioactive waste, utilization and storage.
- Accidents involving radioactive materials.

TEACHING METHODS:

Lecture

LEARNING OUTCOMES:

The student is able to name and implement the rules of working in ionizing radiation (K1A_W06, K1A_W07, K1A_K06), he or she is able to describe the effect of this radiation on live tissue (KW_04, KW_07, K1A_K06), the student is able to describe and implement the methods of radiation measurement (K1A_W06, K1A_W10, K1A_W12, K1A_U02, K1A_U03), the student knows the current guidelines on radiological protection (K1A_W11, K1A_K06).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Passing two tests.

STUDENT WORKLOAD:

- Taking part in the lectures: 30h
- Preparation for the lectures: 20h

Total: 50h, 2 ECTS.

The workload requiring direct participation of the instructor: 30h, 1 ECTS.

RECOMMENDED READING:

[1] M. Kubicka, J. Barczyk, *Skuteczna ochrona radiologiczna w medycynie*, Verlag-Dashofer, 2008.

OPTIONAL READING: -

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

ETHICS OF MEDICAL PROFESSIONS

Course code: **12.0-WF-FizTP-EZaMe**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Humanities**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Lecture	30	2	VI	Grade	

COURSE AIM:

Familarizing the student with the ethical aspects of the work of the medical staff, especially the medical physicist's work.

ENTRY REQUIREMENTS:

None

COURSE CONTENTS:

- Definition and origin of ethics.
- Ethics in medicine.
- Medical professions and their ethos.
- Illness as a critical moment.
- Patients in healthcare system and in biomedical research.
- The conflict between the treatment cost and the needs of the patient and the society. The ethics dilemmas in the biomedical research (clinical trials).
- The medical physicist as a person and a medical expert in the face of death and incurable disease.
- Polish law on the profession of medical physicist and other medical professions.
- The relationship between the medical staff and the patient and his/her family.
- Patient-medical staff confidentiality and its boundaries.
- Professional responsibility.
- Ethical and moral problems of taking medical desissions in extreme situations.
- Medical staff and the society in the context of health promotion.
- Continuing professional, moral and ethical development.

TEACHING METHODS:

Lecture

LEARNING OUTCOMES:

The student knows and can discuss basic notions and problems of ethics and bioethics (K1A_W13, K1A_K03, K1A_K08), he or she is able to relate these to the patient-medical staff – society relationship (K1A_W12, K1A_W13, K1A_K03). The student is able to discuss various situations, which are present in the work of the medical physicist in which critical decision with ethical and moral consequences must be taken (K1A_W13, K1A_K02, K1A_K03).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Positive assessment from the test.

STUDENT WORKLOAD:

Taking part in the lectures – 30 h

Preparation for the lectures – 15 h

Total: 45 h, 2 ECTS.

The workload requiring direct participation of the instructor: 30 h, 1,5 ECTS.

RECOMMENDED READING:

[1] S. Konstańczak, *Etyka pielęgniarska*, Engram, 2010

[2] L. Vaughn, *Bioethics: principles, issues and cases*, Oxford University Press, 2009

OPTIONAL READING: -

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

LANGUAGE CULTURE

Course code: **08.0-WF-FizTP-KuJęz**

Type of course: **optional**

Language of instruction: **Polish**

Director of studies: **mgr Irmina Kotlarska**

Name of lecturer: **mgr Irmina Kotlarska**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					1
Lecture	30	2	VI	Pass/Fail	

COURSE AIM:

The aim is to enhance efficiency in using Polish language and to increase cultural awareness, linguistic sensitivity.

ENTRY REQUIREMENTS:

None

COURSE CONTENTS:

Language as a means of communication, diversity of language and linguistic norm; fromal and informal register; linguistic and communicative competence, a standard communication situation, politeness, rudeness and aggression in public statements, the modern media communication and media dialect.

TEACHING METHODS:

Lecture, discussion, working with text.

LEARNING OUTCOMES:

- Student develops and improves skills of evaluation of language innovations, recognize their mistakes and make corrections. Improves the ability to use dictionaries, and other sources of knowledge about the language K1A_U06), (K1A_U07), (K1A_K01), (K1A_K04).
- Is gaining in-depth knowledge of the wider culture of the language - the most important principles of linguistic norm; diversity of language. The course is also developing and improving the skills of error detection and correction. In addition, classes are designed to improve the skills of using dictionaries, and other sources of knowledge about language (K1A_U06), (K1A_U07).
- Student is able to evaluate the texts presented in mass communication (K1A_K03).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Active participation in lecture. Preparing tasks for summative assessment in the field of modern linguistic phenomena.

STUDENT WORKLOAD:

Work time in hours	Types of workload	ECTS

30	Attending lectures	0,5
10	Attending tutorial	0,2
20	Preparation for classes	0,3
60	**Total**	**1**

RECOMMENDED READING:

[1] M. Bugajski, *Język w komunikowaniu*, Warszawa 2007.

[2] H. Jadacka, *Kultura języka polskiego, Fleksja, słowotwórstwo, składnia*, Warszawa 2005.

[3] G. Rickheit, H. Strohner, *Handbook of Communication Competence,* Berlin 2008.

OPTIONAL READING: -

PROGRAM PREPARATION:

Mgr Irmina Kotlarska

SOLID STATE PHYSICS FOR ENGINEERS

Course code: **13.2-WF-FizTP-FCSdI**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					6
Lecture	30	2	VI	Exam	
Class	30	2		Grade	

COURSE AIM:

The aim of the course is to provide students with basic knowledge of solid state physics, including the basics of crystallography, diffraction methods for determining the crystal structure, band structure, selected issues in physics of metals, semiconductors, magnetism and superconductivity.

ENTRY REQUIREMENTS:

General physics, Mathematical analysis methods.

COURSE CONTENTS:

1. Crystal lattices, the classification of Bravais lattices and crystal structures.
2. Reciprocal lattice, diffraction methods to determine the crystal structure (Laue condition, Bragg equation, Brillouin zones, geometric structural factor).
3. An electron in a periodic potential, the Bloch theorem.
4. Band theory of solids, metals, semiconductors and dielectrics, examples of band structures.
5. Magnetism.
6. Propagation of waves in the elastic medium, specific heat.
7. Superconductivity.

TEACHING METHODS:

Teaching methods have two forms: lecture and exercises.
During the lecture both theory and selected examples are presented. Next, the examples are recommended to be extended at exercises. Students increase their computational skills by solving these examples in detail. In addition, they discuss selected problems.

LEARNING OUTCOMES:

Students have a basic knowledge of the specific quantum methods. General knowledge (K1A_W01, K1A_W03) is supported by a detailed accounting skills for simple models and the ability to explain undergoing physical phenomena (K1A_U01, K1A_U02).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The course ends with an exam grade. Examination is a written test of theoretical knowledge and practical skills in accounting. The effects of exercise training are reviewed by partial reviews on completed tasks, evaluation of written tests and assessment of accounting skills and understanding of selected topics of condensed matter physics.
Overall rating: arithmetic mean score of the exam and exercises.

STUDENT WORKLOAD:

- Participation in lectures: 30 hours
- Participation in exercises: 30 hours
- Preparation for the exercises: 35 hours
- Consulting for the lecturees and exercises: 5 hours
- Preparation for the completion of the lecture: 25 hours

TOTAL: 125 hours, 6 ECTS.

Contact hours: 65 hours, 3 ECTS.

RECOMMENDED READING:

[1] Neil W. Ashcroft, N. David Mermin, *Solid State Physics*, Harcourt College Publishers 1976.

[2] C. Kittel, *Wstęp do fizyki ciała stałego*, PWN, Warszawa 1999.

[3] L. E. Reichl, *A Modern Course in Statistical Physics*, E. Arnold (Publishers) LTD, University of Texas Press 1980.

OPTIONAL READING:

[1] Internet

PROGRAM PREPARATION:

Dr hab. Mirosław Dudek, prof. UZ

PHYSICS IN NUCLEAR MEDICINE

Course code: **13.2-WF-FizTP-FwMNu**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Lecture	15	1	VI	Exam	
Laboratory	30	2		Grade	

COURSE AIM:

To teach the students the basics of physics, medicine and technology necessary for radiotherapy, including radiation dose calculations

ENTRY REQUIREMENTS:

Foundations of physics course, basic biology and medical biology course, basic course in anatomy and physiology, radiological protection course.

COURSE CONTENTS:

- Statistics of Radiation Counting.
- Production of Radionuclides.
- Interaction of radiation with matter.
- Gas-filled detectors.
- Scintilation and semiconductor detectors.
- Gamma cameras.
- Digital techniques in nuclear medicine.
- DICOM image analysis PACS storage and guidelines.
- Image reconstruction in SPECT.
- Quality control in SPECT i CT.
- Detectors and data acquisition (2D i 3D) in PET.
- Factors influencing the final PET image.
- Calculating Medical Internal Radiation Dose (MIRD) for specific patient groups.
- Documentation of the medical physicist's work, reporting, marking of materials, quality control and rigorous control of the radioactive materials.

TEACHING METHODS:

Lectures, computational exercises, computer laboratory

LEARNING OUTCOMES:

The student is able to enumerate the physical foundations of radiobiology and nuclear medicine (K1A_W06), he or she knows the rules of operation of the equipment used in nuclear medicine (K1A_W06, K1A_W10, K1A_W11, K1A_W12), the student is able to perform basic radiation dose calculations (K1A_U02, K1A_U03), he or she can enumerate, apply and justify the rules of operation and calibration of diagnostic and therapeutic equipment (K1A_W06, K1A_W10, K1A_W12)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Passing the final examination, carrying out all the laboratory exercises and writing all the reports as well as active participation in the classes.

Before taking the examination the student needs to obtain passing grade in the laboratory exercises.

The final grade (after semester VI): the arithmetic average of the examination grade and laboratory exercises grades.

STUDENT WORKLOAD:

- Taking part in the lecture: 15h
- Preparation for the examination: 20h
- Taking part in the laboratory exercises: 30h
- Preparation for the laboratory exercises: 30h
- Consultations: 5h
- Examination: 2h

Total: 102h, 5 ECTS.

The burden of instructed activities 52h which corresponds to 2,5 ECTS.

RECOMMENDED READING:

[1] G. B Saha, Physics and Radiobiology in Nuclear Medicine, 2008.

[2] B. Pruszyński, Radiologia, Wydawnictwo Lekarskie PZWL, 2006

OPTIONAL READING: -

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

ELEMENTS OF MEDICAL RESCUE

Course code: **12.9-WF-FizTP-PRaMe**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **Dr Lidia Najder-Kozdrowska**

Name of lecturer: **Dr Lidia Najder-Kozdrowska**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					2
Laboratory	30	2	VI	Grade	

COURSE AIM:

To teach the students elements of medical rescue: both the practical and theoretical and practical aspects

ENTRY REQUIREMENTS:

Elements of anatomy and physiology.

COURSE CONTENTS:

- Basic notions and tools of medical rescue.
- Cardio-Pulmonary Resuscitation (CPR) in adults.
- CPR in children.
- Cardiac arrest, using the defibrillator.
- Wounds – wound care and dressing of various body parts – basic rules and techniques.
- Bone breaks, dislocations and sprains.
- Positioning and transportation of wounded persons.
- Rescue in communication accidents.
- Rescue in chemical contamination.
- Rescue in radioactive contamination.
- Rescue in the face of bioterrorism.
- Psychology of rescue.
- The organization of medical rescue in Poland.

TEACHING METHODS:

Theory and practical exercises

LEARNING OUTCOMES:

The student is able to provide first aid in typical injuries (K1A_W04). He or she knows the procedures for situations in which human life and health is in danger (K1A_W07, K1A_K06).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Final test

STUDENT WORKLOAD:

- Taking part in classes – 30 hours
- Preparation for the classes – 15 hours

Total: 45 hours, 2 ECTS.

The workload requiring direct participation of the instructor: 30 hours, 1,5 ECTS.

RECOMMENDED READING:

[1] J. Jakubaszko (red.), *Ratownik medyczny*, Górnicki Wydawnictwo Medyczne Wrocław 2003.

[2] A. Zawadzki, *Medycyna ratunkowa i katastrof*, PZWL, Warszawa 2008.

OPTIONAL READING:

[1] M. Kowalczyk, S. Rump, Z. Kołaciński, Medycyna katastrof chemicznych, PZWL, Warszawa 2004.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

ENGINEERING PROJECT - IMAGING, DIAGNOSTICS

Course code: **06.0-WF-FizTP-PIObD**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher directing the project**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Project	30	2	VI	Grade	

COURSE AIM:

Teaching the students how to prepare and document an engineering project

ENTRY REQUIREMENTS:

Elements of electronics, elements of signal analysis, elements of biostatistics, knowledge on the modern medical equipment, knowledge of physiology and anatomy

COURSE CONTENTS:

- Design and implementation of a device to measure the electric action of the heart with the use of the Arduino/Raspberry Pi system. Building software for acquring, pre-rpcessing, filtering and analysis of the resulting signal.
- Design and implementation of a device to measure the O2 saturation adn pulset with the use of the Arduino/Raspberry Pi system. Building software for acquring, pre-rpcessing, filtering and analysis of the resulting signal.
- Design and implementation of a device to measure the galvanic response of the skin with the use of the Arduino/Raspberry Pi system. Building software for acquiring, pre-rpcessing, filtering and analysis of the resulting signal.
- Design and implementation of a device to measure airflow while breathing with the use of the Arduino/Raspberry Pi system. Building software for acquring, pre-rpcessing, filtering and analysis of the resulting signal.
- Design and implementation of a device to measure the arterial pressure with the use of the Arduino/Raspberry Pi system. Building software for acquiring, pre-processing, filtering and analysis of the resulting signal.
- Design and implementation of a device to measure the electromyographic signal with the use of the Arduino/Raspberry Pi system. Building software for acquiring, pre-rpcessing, filtering and analysis of the resulting signal.
- Design and implementation of software for off-line analysis of a filtered ECG signal.
- Design and implementation of software for tissue edge detection.
- Design and implementation of software for detecting brain activation in fMRI signal.
- Design and implementation of a teleinformatic solution with an electrocardiograph working in a local network with a distant computer for analyzing the acquired recordings.

TEACHING METHODS:

Laboratory exercises

LEARNING OUTCOMES:

The student is able to design and implement the appropriate device as well as writing software for it or is able to design and build appropriate piece of software and use external data for analysis (K1A_W03, K1A_W04, K1A_W06, K1A_U01, K1A_U02, K1A_U03, K1A_U05, K1A_U07). The student can work in a team, knows the importance of fulfilling her or his tasks, understand the influence of his or her own detication for the success of the others (K1A_K02, K1A_K06).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Accomplishment of the project or documented effort towards fulfilling the project

STUDENT WORKLOAD:

- Work in the laboratory: 30 h
- Preparation for the laboratory: 65 h
- Consultations: 10 h

Total: 105 hours, 5 ECTS.

The workload requiring direct participation of the instructor: 40 hours, 2 ECTS.

RECOMMENDED READING:

[1] Timothy L. Warner, Hacking Raspbery Pi, Que Publishing, 2013.

[2] Magnus Lie Heatland, Beginning Python: From Novice to Professional, 2nd Edition (The Experts Voice in Open Source), Apress 2008.

OPTIONAL READING:

[1] John Boxall, Arduino Workshop: A Hands-On Introduction with 65 Projects, No Starch Press 2013.

REMARKS:

Students work in groups of 3 (in exceptional situations in pairs) – each group tries to accomplish ONE project. The details of the project are worked out by the project participants and the instructor during the fiirst class.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

SEMINAR

Course code: **13.2-WF-FizTP-Semin**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher directing the seminar**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					5
Seminar	30	2	VI	Grade	

COURSE AIM:

The aim of the course is to prepare students for the diplom exam, which is to determine that the intended learning outcomes of the studies are being achieved and covers general issues of basic physics, medical physics, and the contents of the thesis. Students have an opportunity to revise and consolidate their knowledge and skills by giving self-prepared presentations. The list of topics includes basic issues in physics. Another aim is to teach students practical skills necessary to present and navigate their lessons.

ENTRY REQUIREMENTS:

Every student should pass all previous obligatory courses in technical physics.

COURSE CONTENTS:

Issues are divided into two groups. Every student at least three times per semester should refer some issues from the group A "at the blackboard" and at least twice some issues from the group B as a multimedia presentation.

Group A

- Measurement in Physics
- Newton's principles, inertial reference systems
- Non-inertial reference systems, fictitious forces
- The laws of conservation of energy, linear momentum and angular momentum
- Rigid body dynamics
- Kepler's laws, a gravitational field
- Oscillations: harmonics, damped, forced resonance
- Aco- Principles of thermodynamics, heat engines, entropy
- Thermodynamic description of phase transitions
- Basic physical laws of hydrostatics and hydrodynamics
- The equation of state for an ideal gas and van der Waal's equation
- Electromagnetic waves and spectroscopy
- Electrical properties of matter
- Electrical conductivity in solids
- Magnetic properties of matter
- Optical properties of crystals

- Maxwell equations
- Electrostatics, capacitors, dielectrics
- Magnetostatics
- Electromagnetic induction
- Geometrical optics, the basics of light reflection and diffraction
- Postulates of quantum mechanics, the essence of quantization
- Dynamics of the quantum system

Group B

- special relativity, relativistic mechanics
- the properties of atomic nuclei, nuclear transformations
- atoms in magnetic fields
- atoms and molecules, forming molecules with atoms
- interference and diffraction of light
- Electron Paramagnetic Resonance and Nuclear Magnetic Resonance
- the dynamics of crystal lattices, specific heat of solids
- the piezo-, pyro- and ferroelectric properties
- the dia-, para- and ferromagnetic properties
- physical properties of semiconductors, doping, p-n junctions
- transport phenomena, diffusion, viscosity, thermal and electrical conductivity
- the experimental basis of quantum mechanics
- periodic table of the elements and atomic structure
- superfluidity, superconductivity, Bose-Einstein condensate as examples of macroscopic quantum phenomena
- lasers and their applications

TEACHING METHODS:

Student must select a topic and form of presentation at least one week in advance. The recipients of speeches are other seminar participants with the teacher, who during the speeches - as needed - corrects or completes the statement.

LEARNING OUTCOMES:

Students can complete and organize their knowledge in physics presented in previous years (K1A_W01, K1A_K04). The student is able to present the various sections of physics, both theoretical and experimental (K1A_W03, K1A_W06) and specify and describe their application in the contemporary world (K1A_W12). If necessary statements are supplemented by the teacher with information of the latest scientific advances (K1A_U07). Students are able to present their knowledge using a variety form of expressions (K1A_U06, K1A_U09, K1A_K05).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The student's assessment is related to his/her presentations and activity during discussions. The final evaluation criterion is based on thresholds.

STUDENT WORKLOAD:

- Participation in the seminar: 15 x 2 = 30 hours
- Preparation to presentations: 50 hours
- Consultations: 20 hours

Total: 100 hours, 5 ECTS.

The workload requiring direct participation of the instructor: 50 hours, 2,5 ECTS.

RECOMMENDED READING:

[1] D. Halliday, R. Resnick, J. Walker, *Fundamentals of Physics 1 - 5*, Wydawnictwo Naukowe PWN, Warszawa 2005.

OPTIONAL READING:

[1] Andrzej Hrynkiewicz, Eugeniusz Rokita, *Fizyczne metody diagnostyki medycznej i terapii*, PWN, Warszawa 2000.

[2] J. Massalski, M. Massalska, *Fizyka dla inżynierów I i II*, WNT, Warszawa 2008.

[3] Paul A. Tipler, Ralph A. Llewellyn, *Fizyka współczesna*, PWN, Warszawa 2011.

PROGRAM PREPARATION:

Prof. dr hab. Andrzej Drzewiński

PSYCHOLOGY OF RELATIONS WITH PATIENTS

Course code: **14.4-WF-FizTP-PsKoP**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher giving the lecture**

Name of lecturer: **Academic teacher from the Faculty of Education, Sociology and Health Sciences**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					3
Lecture	30	2	VII	Grade	

COURSE AIM:

Familiarizing the student with the psychological aspects of working with a patient. Conferring to the student the knowledge about the reactions of both the patient and medical staff to serious illness, death or the necessity to perform a painful procedure, as well as teaching about coping strategies.

ENTRY REQUIREMENTS:

None

COURSE CONTENTS:

- Definition of psychology, the role of psychology in medicine, nomenclature
- The biological foundations of behavior
- Developmental psychology
- Models of identity
- The social noticing – how we arrive at understanding other people
- Motivations and emotions
- Physical health and behavior
- Symptoms, the perception of one's own health and the attitude to oneself (e.g. placebo effect)
- Stress
- Personal prejudice and preferences in the relations with the patient
- Communication with the patient and his family
- Empathy
- Medical staff in the face of serious illness, grievous bodily harm, mental illness and death
- Decision making in critical and extreme situations, dealing with responsibility
- Psychological assistance for medical staff

TEACHING METHODS:

Lecture

LEARNING OUTCOMES:

The student is able to enumerate the basic problems related to psychology which are present in the work of the medical physicist (K1A_K04, K1A_W13), he or she is able to adequately behave in the face of illness and is able to communicate with the patient and his/her family (K1A_K03), the student is aware how suffering, incurable disease or death can influence a medical professional

(K1A_K03), he or she can react in critical situation, he or she is able to get psychological help for him/herself or for the patient (K1A_K02, K1A_W13)

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Final test

STUDENT WORKLOAD:

Participation in the lectures: 30 h

Preparation for the lectures: 30 h

Final test: 2 h

Total: 62 hours, 3 ECTS.

The workload requiring direct participation of the instructor: 32 h, 1,5 ECTS.

RECOMMENDED READING:

[1] S. Ayers, R. Visser, *Psychology for Medicine*, Stage Publications, 2011

OPTIONAL READING:

[1] T. Gordon, W. S. Edwards, *Rozmawiać z pacjentem.. Podręcznik doskonalenia umiejętności komunikacyjnych i budowania partnerskich relacji; wskazówki dla: lekarzy, personelu medycznego, wolontariuszy, rodziny chorego*, Academica, 2009.

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

PROFESSIONAL PRACTICE

Course code: **12.9-WF-FizTP-PraZa**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr Lidia Najder-Kozdrowska**

Name of lecturer: **dr Lidia Najder-Kozdrowska**

Form of instruction	Number of teaching hours	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					6
Practice	80	20	VII	Pass/Fail	

COURSE AIM:

Practical recognition of trade of medical physicisit in hospilas, clinics and in factories produced medical equipments applied in diagnosctic and medical therpay.

ENTRY REQUIREMENTS:

The credit of 6 smesters in filed of technical physics.

COURSE CONTENTS:

The subcject area of the practice is connected with the profile of establishment. The program of the practice is given by the attendant.

TEACHING METHODS:

Practice. Laboratory. Briefing. Presenation of style of work and fabrication.

LEARNING OUTCOMES:

Student knows the organization and rules of working of units using in physics and can apply it in medical units (K1A_W06). Student knows the rules of occupational safety and health (K1A_W07). Student has a basic knowledge on planned obsolenscene, especcialy for units used at immaging by the hard radiation and for units in radiotherapy (K1A_W10). Student knows basic technical rules effective in work of medical physicist and in other medical trades. Student can explain medical and technical argumentation of these rules (K1A_W11). Student knows basic methods, units and materials used in medical physic and can give argumentation on their application (K1A_W12). Student can use popular sofwares and operating systems for work with medical units (K1A_U04). Student can formulate physical problem and gives their solution by application of knowledge in field of physics, engineering and medical science (K1A_U05). Student learn with different sources of knowledge in native and foreign langue. Student can master new technology usied in diagnostic and therapy (K1A_U07). Student is sensible of own knowledge and skills. Student is sensible of furher education (grad school) (K1A_K01). Student is sensible of responsibility for own work and work in team. Student can turen to experts and ask for help K1A_K02). Student is sensible of the role of medical physicist in society (K1A_K05). Student works in accordance with occupational safety and health for the guarantee own and environment's safety (K1A_K06). Student can think and work in resourceul way (K1A_K07).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Submittal of journal of practice with the opinion of the attendant.

STUDENT WORKLOAD:

- Participation in practice: 80 hours
- Preparing for practice: 40 hours
- Preparation of journal of practice: 10 hours

Total: 130 hours, 6 ECTS.

The workload requiring direct participation of the instructor: 80 hours, 4 ECTS.

RECOMMENDED READING:

Literature connected with the profile of the establishment (given by the attendant of practice).

OPTIONAL READING:

As mentioned above.

PROGRAM PREPARATION:

Dr Lidia Najder-Kozdrowska

SPECIALIST LECTURE – STATISTICAL ANALYSIS OF FUNCTIONAL MAGNETIC RESONANCE DATA

Course code: **13.2-WF-FizTP- WykSp**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **dr hab. Jarosław Piskorski, prof. UZ**

Name of lecturer: **dr hab. Jarosław Piskorski, prof. UZ**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					6
Lecture	30	2	VII	Exam	

COURSE AIM:

To familiarize the students with the statistical methods of analyzing the fMRI data, which is an intersection of areas covered during earlier semesters i.e.: statistical data analysis, computerized medical data processing, anatomy, signal analysis as well as one of the noninvasive diagnostic methods – functional magnetic resonance imaging (fMRI).

ENTRY REQUIREMENTS:

The knowledge of the rules of operation of fMRI, the knowledge of the elements of biostatistics, the knowledge of the elements of signal analysis, the knowledge of the elements of anatomy.

COURSE CONTENTS:

- Review of the fMRI.
- Data formats used in fMRI.
- Modeling the BOLD response.
- Pre-processing.
- Generalized linear model (GLM).
- The problem of multiple comparisons.
- Group analysis.
- Coherence analysis.
- Granger causality.
- Classification methods.
- Localization of brain activity.
- Inference on brain connectivity.
- Predicting physical pathological states and psychological states.

TEACHING METHODS:

Lecture, task for completion

LEARNING OUTCOMES:

The student can describe the rules of operation of fMRI and their physical foundations (K1A_W04, K1A_W06, K1A_W12, K1A_U06), he or she can apply the computational methods acquired in earlier courses to analyzing the fMRI signal (K1A_W02, K1A_W03, K1A_U01, K1A_U03), the student can quickly learn an analytical technique at the practical level and later also at the theoretical level (K1A_U07), the student can relate the results of his or her analyses to the relations with physical and psychological states which are described in the literature (K1A_U02, K1A_U07).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Examination, task completion

STUDENT WORKLOAD:

- Taking part in the lectures: 30 h
- Preparation for the lectures: 55 h
- Unassisted solution of a problem related to the lecture: 30 h
- Consultations: 3 h
- Examination: 2 h

Total: 120 h, 6 ECTS.

The workload requiring direct participation of the instructor: 35 h, 2 ECTS.

RECOMMENDED READING:

[1] F. Gregory Ashby, Statistical Analysis of fMRI Data, The MIT Press; 1 edition (March 11, 2011).

OPTIONAL READING:

[1] Russell A. Poldrack, Jeanette A. Mumford, Thomas E. Nichols, Handbook of Functional MRI Data Analysis, Cambridge University Press; 1 edition (August 22, 2011).

PROGRAM PREPARATION:

Dr hab. Jarosław Piskorski, prof. UZ

BACHELOR THESIS SEMINAR

Course code: **13.2-WF-FizTP-SemDy**

Type of course: **compulsory**

Language of instruction: **Polish**

Director of studies: **The academic teacher directing the seminar**

Name of lecturer: **Academic teacher from the Faculty of Physics and Astronomy**

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
TECHNICAL PHYSICS – first degree studies					7
Seminar	30	2	VII	Grade	

COURSE AIM:

The aim of the course is to prepare students for the diploma exam, in particular for the thesis writing. Aim of the course is accomplished through individually prepared presentations under supervision of the seminar lecturer.

ENTRY REQUIREMENTS:

Every student should pass all obligatory courses in technical physics.

COURSE CONTENTS:

Analysis and presentation their results in comparison with the state of the art, correct refering to the existing literature, thesis editing and presentations. n discussions on the presented issues all students are involved.

TEACHING METHODS:

The seminar acquaints students to the principles of a diploma thesis writing including the work plan, appropriate form of analysis and presentation of obtained results and editorial side. At the seminar, each student delivers three oral presentations: 1) the presentation of the "state of the art" for the subject in which the student performs thesis, 2) the presentation of preliminary results of the student's work in comparison with previous results of other authors, 3) the thesis presentation close to the final version. All presentations should be consulted with the thesis supervisor.

LEARNING OUTCOMES:

The student learns and knows guiding principles for scientific research (in relation to his/her diploma project) (K1A_W03, K1A_W12, K1A_K02), documentation of the data (K1A_U08), analysis (K1A_U01, K1A_U02, K1A_U05) and critical evaluation of the results (K1A_W03). Student is able to speak about physical and technical issues of language in a manner understandable to a general audience (K1A_U06, K1A_U09, K1A_K05).

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The student's assessment is related to his/her presentations and activity during discussions. The final evaluation criterion is based on thresholds.

STUDENT WORKLOAD:

- Participation in the seminar: 15 x 2 = 30 hours

- Preparation to presentations: 3 x 10 = 30 hours
- Consultations: 20 hours
- Diploma thesis preparation: 70 hours

Total: 150 hours, 7 ECTS.

Direct participation of the teacher: 50 hours, 2.5 ECTS.

RECOMMENDED READING:

[1] Literature on the subject agreed upon by the supervisor.

PROGRAM PREPARATION:

Prof. dr hab. Andrzej Drzewiński