Zał. nr 4 do ZW 64/2012

FACULTY Mechanical and Power Engineering / DEPARTMENT……

SUBJECT CARD

Name in Polish …… Fizyka 1…….
Name in English …...Physics 1…….
Main field of study (if applicable): …….
Specialization (if applicable): …….
Level and form of studies: 1st level, part-time
Kind of subject: obligatory, university-wide
Subject code FZP2109W
Group of courses NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	32				
Number of hours of total student workload (CNPS)	120				
Form of crediting	Examination				
For group of courses mark (X) final course					
Number of ECTS points	4				
including number of ECTS points for practical (P) classes	0				
including number of ECTS points for direct teacher-student contact (BK) classes	4				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

Competences in the subjects Mathematics and Physics with astronomy at the secondary school level

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SUBJECT OBJECTIVES

C1. Acquisition of a basic knowledge, including the application aspects, in the following sections of classical physics:

C1.1. classical mechanics,

C1.2. oscillations and wave motion,

C1.3. thermodynamics.

C2. Acquiring the ability to understand qualitatively and quantitatively – based on the laws of physics – a selected physical phenomena and processes in the fields of

C2.1. classical mechanics,

C2.2. oscillations and wave motion,

C2.3. thermodynamics.

C3. Consolidation of social skills, including

- an emotional intelligence involving the ability to work in a group of students and aiming at the effective problem-solving

- responsibility, honesty and integrity in the behavior
  compliance with the customs applicable in the academic community and in the society.

Issues intended for self-study are drafted in italics

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge: Has a basic knowledge in the fields of classical mechanics, wave motion and phenomenological thermodynamics.

PEK_W01 – knows the importance of physical discoveries and achievements for engineering sciences and the progress of civilization

PEK_W02 – knows the basic principles of dimensional analysis and estimation of physical quantities

PEK_W03 – knows the basics of vector calculus in a rectangular coordinate system

PEK_W04 – has knowledge of the kinematic description of linear and nonlinear motion (projectile motion, circular motion, kinematic relationships between linear and angular quantities)

PEK_W05 – has knowledge of the basics and applications of dynamics of motion; has detailed knowledge of a) *the reference systems (inertial and non-inertial), b) the importance in the dynamics of physical quantities such as mass and force,* c) main types of fundamental interactions and forces observed in nature (conservative, nonconservative, central, friction, and inertial), d) the Newton's principles and the scope of their applicability, e) a correct formulation of the equation of motion, f) the physical meaning of the Galilean transformation, g) the dynamics of nonlinear motion of particles and bodies in the inertial reference frame, h) the dynamics of particles and bodies in the non-inertial reference frame, i) the physical sense of inertia including its manifestations and consequences

PEK_W06 – has knowledge of the conservative and nonconservative forces observed in nature and everyday life; is familiar with the concept of a) a conservative force, b) a force field, including a conservative force field, c) a mechanical work and power, d) a kinetic and potential energy; knows the work - kinetic energy theorem; has the knowledge to explain the relationship of a conservative force with the potential energy; is familiar (including the mathematical justification) with the principle of conservation of mechanical energy for particles and bodies in the conservative force field

PEK_W07 – knows and understands the concept of a) an impulse, b) a momentum of a particle and a system of material points; knows the second law of dynamics formulation using the concept of momentum; has knowledge of a) the principle of conservation of momentum with regard to a particle and a system of material points, including the conditions of its applicability, b) elastic and inelastic collisions; *knows and understands the concept of system of material points and its center of mass; has knowledge about the dynamics of the center of mass of system of material points*

PEK_W08 – is familiar with the concept of *a) moment of force relative to a point and an axis of rotation, b) angular momentum of a particle, a system of material points and a rigid body, relative to a point and an axis of rotation, c) moment of inertia of a particle, a system of material points and a rigid body, relative to an axis of rotation*; knows the second law of dynamics for the rotation of a rigid body about a fixed axis of rotation; has knowledge about the

kinetic energy of rotation, the work and the power in rotational motion; knows the correct qualitative and quantitative description of the phenomenon of precession and the combined translational and rotational motion of a rigid body; has knowledge of the a) principle of conservation of angular momentum of a particle, a system of material points and a rigid body relative to a fixed axis of rotation, *b) applicability of the principle of conservation of angular momentum*

PEK_W09 – knows the vector form of the law of universal gravitation; is familiar with the concept of a) strength and potential of the gravitational field, b) gravitational potential energy of a single body and a system of objects; has knowledge of the a) principle of conservation of mechanical energy of a single body and a system of objects in a gravitational field, b) relationship of the potential with the field intensity and of the gravitational force with the gravitational potential energy*, b) Kepler's laws and the justification based on the law of universal gravitation and the law of conservation of angular momentum of the planet; is familiar with the concept of first, second and third cosmic velocity*

PEK_W10 – *knows the basics of statics and elastic properties of liquids and solids*

PEK_W11 – *knows the basics of hydrostatics and hydrodynamics of fluids; has detailed knowledge of: the hydrostatic pressure, Pascal and Archimedes' laws, the surface tension and the associated effects, fluid flow types, continuity and Bernoulli's equation, the fluid viscosity and the associated effects, the dynamics of the motion of bodies in a viscous medium, Stokes' laws*

PEK_W12 – has knowledge on the basis of kinematics and dynamics and applications of oscillatory motion; has detailed knowledge of a) a simple harmonic motion of a mathematical, physical and torsion pendulum and of the particle subjected to a potential force and performing small oscillations around the equilibrium point, b) a damped oscillatory motion, c) the forced vibrations under an external sinusoidal force; has knowledge of the physics of mechanical resonance

PEK_W13 – has knowledge on the basics of wave motion and its applications; has detailed knowledge of a) *the generation and the basic properties of mechanical waves, b) types of waves,* c) the monochromatic plane wave equation, d) basic physical quantities of wave motion (wave length and frequency, wave vector, circular frequency) and their units, e) velocities related to the wave motion (phase velocity, medium particles velocity, group velocity), f) the dependence of the velocity of longitudinal and transverse wave on the elastic properties of the medium, g) the mechanical energy transport by waves (the energy and average power, the intensity, the average energy density of the wave in the medium), *h) the dependence of the wave intensity on the distance from the source*

PEK_W14 – has detailed knowledge about a) the generation, type and properties of the acoustic wave (the speed of sound in air, the volume level and the intensity of the wave, the energy transport), b) laws of refraction and reflection, c) *the pressure and the force exerted by the wave incident on the surface,* d) Doppler effect, *e) applications of ultrasound,* f) the wave interference (the superposition principle), g) standing waves and sound sources, h) the beats, *i) selected applications of sound and ultrasound*

PEK_W15 – has knowledge of the zeroth and first laws of thermodynamics; knows the basic concepts (macroscopic system, state of equilibrium, thermodynamic parameters, state functions,

thermodynamic processes, ideal gas, equation of state for ideal and real gases); has detailed knowledge of a) the temperature, the thermodynamic temperature scale and the units used in the different temperature scales, b) the definition of the Kelvin unit, c) the concept of internal energy of the system, d) the elementary work done on an ideal gas, e) the work done on or by the gas and the heat flow in thermodynamic processes for an ideal gas

PEK_W16 – has a basic knowledge of the second and third laws of thermodynamics; has detailed knowledge of a) reversible and irreversible processes, b) the entropy of a macroscopic system, the content of the second law and the elementary value of the system entropy change, c) methods for the quantitative determination of the ideal gas entropy changes, and the thermodynamic potentials d) the thermodynamics of heat engines and their efficiency in the straight and reverse cycles, e) the third law of thermodynamics

PEK_W17 – has knowledge on the basics of statistical thermodynamics; has detailed knowledge of a) objectives and mathematical formalism of statistical thermodynamics, the classical and quantum statistics b) a macroscopic thermodynamic parameter as a random variable; c) the microstate, the macrostate and the thermodynamic probability, d) the Boltzmann-Planck's statistical interpretation of the entropy, e) the Boltzmann distribution function (barometric formula) f) the Maxwell distribution function for the ideal gas particle velocities, g) the most probable speed and the mean square velocity of the ideal gas particles, h) the relationship between the average energy of the particles and the number of degrees of freedom, i) the microscopic interpretation of the temperature and pressure of the ideal gas, j) the principle of equipartition of thermal energy

relating to skills: Is able to correctly and effectively apply the learned principles and laws of physics to the qualitative and quantitative analysis of selected physical issues of the engineering type

PEK_U01 – is able to: a) identify and justify physics discoveries and achievements that have contributed to the progress of civilization, b) explain the physical basis of operation of common use devices

PEK_U02 – is able to: a) apply the basic principles of dimensional analysis and qualitative analysis; b) estimate the values of simple and complex physical quantities

PEK_U03 – is able to: a) distinguish between the scalar and vector quantities, b) present the vector quantities in the Cartesian coordinate system, c) use the known elements of vector calculus and, in particular, is able to determine the norm of vector, the angle between the vectors, products of vectors (scalar, vector, mixed and triple)

PEK_U04 – can determine – using the Galilean transformations – kinematic quantities in inertial reference frames moving relative to each other

PEK_U05 – is able to identify and define kinematic quantities (position vector, velocity, total, tangential, and radial acceleration) in translational and rotational motion and quantitative relationships between the linear and angular kinematic quantities

PEK_U06 – is able to correctly identify the forces acting on an object in the inertial and non-inertial system and determine the resultant force

PEK_U07 – can apply the principles of dynamics to describe the motion of a body in the inertial

reference system, and, in particular, can a) properly formulate the vector and scalar equation of motion in the selected coordinate system, b) solve the formulated scalar equations of motion, taking into account the initial conditions

PEK_U08 – can apply the principles of dynamics to describe the motion of a body in the non-inertial reference system, and, in particular, can a) identify the forces acting on the given particle or body and properly formulate the vector and scalar equation of motion in the non-inertial coordinate system, b) explain the observed effects related to the rotation of the Earth

PEK_U09 – is able to correctly use the concept of work and energy to the description of physical phenomena, and, in particular, to apply the principle of conservation of energy to solve the problems concerning the kinematics and dynamics of motion of the given particle or body; knows how to determine the value of a) mechanical work and power of the fixed and variable fotce, kinetic and potential energy, b) changes in the kinetic energy of the particle / body with the use of the work - kinetic energy theorem, c) conservative force on the basis of a given analytical form of the potential energy

PEK_U010 – can apply the principles of dynamics to describe the system of material points, and in particular to determine the value of: impulse of the force acting on the body, momentum of the particle / system of material points and the center of mass of the system of material points and quantitatively analyze the motion of the center of mass of the system of material points under the influence of the resultant of the external forces

PEK_U011 – can properly apply the principle of conservation of momentum for quantitative and qualitative analysis of the dynamic properties of the system of material points, and, in particular, to the quantitative analysis of elastic and inelastic collisions

PEK_U012 – can apply the concept of torque and angular momentum to the analysis of simple problems related to the kinematics and dynamics of rotation of the rigid body about a fixed axis, and, in particular, knows how to determine the value of a) *moment of the force with respect to the point / axis of rotation, b) the angular momentum of a particle, a system of particles and a rigid body relative to the point / axis of rotation,* c) formulate and solve the equation of motion of a rigid body rotating around a fixed axis of rotation, d) qualitatively characterize the phenomenon of precession, e) formulate and solve the equation for the combined translational and rotational motion of a rigid body

PEK_U013 – is able to apply the principle of conservation of angular momentum to solve selected physical and technical problems

PEK_U014 – can apply the concept of work and kinetic energy of a rigid body to solve problems related to the rotation of a rigid body, and, in particular, can determine the value of a) the kinetic energy of rotation, work and power in rotational motion, b) changes in rotational kinetic energy of the particle / body using the work - kinetic energy theorem for rotational movement

PEK_U015 – is able to: a) justify the conservative nature of the gravitational field, *b) explain the physical meaning of Kepler's laws, c) properly apply the principle of conservation of mechanical energy of the body / system of bodies in the gravitational field*, knows how to determine the value of: a) strength and potential of the gravitational field, b) gravitational potential energy of the body and the system of bodies, *c) first, second and third cosmic velocity*

PEK_U16 – is able to analyze and solve simple tasks on hydrostatics and hydrodynamics of fluids and, in particular, can determine the value of the surface tension, the speed and efficiency of fluid flow; is able to solve simple problems related to the dynamics of bodies in fluids, taking into account the resistance forces

PEK_U17 – can properly describe the properties of periodic motion, and, in particular, to formulate and solve the differential equations of oscillatory motion, for simple cases (mathematical, physical and torsion pendulum and the particle performing small oscillations around the stable equilibrium point); can analyze kinematic and dynamic properties of harmonic motion under the action of resistance forces and of a periodic exciting force; is able to determine the period of oscillation and qualitatively and quantitatively characterize the effect of mechanical resonance

PEK_U18 – is able to: a) explain the relationship of the wave motion with the elastic properties of the medium, b) quantitatively characterize the mechanical energy transport by traveling waves, c) correctly describe quantitatively the phenomenon of diffraction, interference, polarization and the pressure exerted by the wave incident on the surface

PEK_U19 – *can explain, based on knowledge in the field of the standing waves, the physical principles of acoustic waves generated by sound sources; can explain and determine: a) the frequency of the received waves, depending on the motion of the source and the receiver (the Doppler effect), b) the beat frequency*

PEK_U20 – can use the first law of thermodynamics for the quantitative and qualitative description of an ideal gas conversions and determine the value of: the heat transfer from the system to the surrounding, the work done on or by the ideal gas, the internal energy changes in the conversions; knows how to graphically represent the ideal gas conversions, can justify / derive the Mayer's formula and derive the adiabatic equation

PEK_U21 – can determine using the first and second laws of thermodynamics, the values of: a) the entropy changes of the thermodynamic system, in particular, the ideal gas subjected to specified thermodynamic conversion, b) the efficiency of heat machines and engines operating in a power or heat pump cycles, c) quantitatively describe the thermal conductivity, diffusion and viscosity

PEK_U22 – is able to: a) calculate the height dependence of the pressure using the Boltzmann distribution function, b) formulate the statistical interpretation of entropy, c) derive using the Maxwell distribution function, the temperature dependence of the most probable velocity and the mean square velocity of the ideal gas particles, d) apply the principle of equipartition of thermal energy, e) define the microscopic interpretation of the temperature and pressure of the ideal gas

relating to social competences: Consolidate the competence in:

PEK_K01 – finding information and its critical analysis,
PEK_K02 – team cooperation on improving the strategy selection method designed to optimally solve the problems assigned to group,
PEK_K03 – understanding of the need for self-study, including the ability to improve attention and focus on what's important and to develop the ability to apply knowledge and skills,
PEK_K04 – developing the capacity to self-esteem and self-control and responsibility for the results of actions taken,
PEK_K05 – compliance with the customs and rules of the academic environment,
PEK_K06 – independent and creative thinking,

PEK_K07 – the impact of discoveries and achievements of physics to technical and social progress and environmental protection through openness to knowledge and curiosity relating to scientific achievements and advanced technologies,

PEK_K08 – objective evaluation of arguments, rational explanation and justifying of his own point of view, using the knowledge of physics.

PROGRAMME CONTENT

Form of classes – lecture		Number of hours
Lec 1	Organizational issues. The methodology of physics.	1
Lec 2	The kinematics of a material point.	4
Lec 3	The dynamics of a material point.	4
Lec 4	The non-inertial reference systems.	2
Lec 5	Mechanical work, energy and power.	2
Lec 6	The principle of conservation of momentum. Other formulation of the second law of dynamics.	2
Lec 7	The dynamics of a rotational motion of a rigid body.	2
Lec 8	Gravitation. The law of universal gravitation. Kepler's laws.	2
Lec 9	Oscillatory motion - definitions, types of.	2
Lec 10	Oscillatory motion - damped, forced.	1
Lec 11	Mechanical waves. Acoustics.	2
Lec 12	Pascal's, Archimedes', Bernoulli's Principles	2
Lec 13	Phenomenological thermodynamics - basic concepts and definitions.	2
Lec 14	Phenomenological thermodynamics - the ideal gas equation of state.	2
Lec 15	Statistical thermodynamics.	2
	Total hours	**32**

TEACHING TOOLS USED

N1. Traditional lectures aided with slides presentations.

N2. Classes – discussions of solutions of exercises.

N3. Classes – students written short tests.

N4. Classes – e-tests organized by the Department of Distant Learning (http://www.dko.pwr.wroc.pl/).

N5. Consulting.

N6. Student’s own work – individual preparation for classes.

N7. Student’s own work – individual studies and preparation for a final exam.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation(F – forming (during semester), P –	Educational effect number	Way of evaluating educational effect achievement

concluding (at semester end)		
F1	PEK_W01 - PEK_W17; PEK_U01 - PEK_U22; PEK_K03 - PEK_K08.	Examination
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] D. Halliday, R. Resnick, J. Walker, *Podstawy fizyki*, tomy 1.÷2., Wydawnictwo Naukowe PWN, Warszawa 2003; J. Walker, *Podstawy fizyki. Zbiór zadań*, PWN, Warszawa 2005 i 2011.

[2] I.W. Sawieliew, *Wykłady z fizyk*i, tom 1. i 2., Wydawnictwa Naukowe PWN, Warszawa, 2003.

[3] W. Salejda, *Fizyka a postęp cywilizacyjny* (45,35 MB), *Metodologia fizyki* (1,1MB); the texts are available online from

http://www.if.pwr.wroc.pl/index.php?menu=studia&left_menu=jkf

SECONDARY LITERATURE (IN POLISH):

[1] J. Massalski, M. Massalska, *Fizyka dla inżynierów*, cz. 1. i 2., WNT, Warszawa 2008.

[2] J. Orear, *Fizyka*, tom 1. i 2., WNT, Warszawa 2008.

[3] K. Sierański, K. Jezierski, B. Kołodka, *Wzory i prawa z objaśnieniami*, cz. 1. i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 2005; K. Sierański, J. Szatkowski, *Wzory i prawa z objaśnieniami*, cz. 3., Oficyna Wydawnicza SCRIPTA, Wrocław 2008..

[4] W. Salejda, M.H. Tyc, *Zbiór zadań z fizyki*, Wrocław 2001 – podręcznik internetowy dostępny pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/listamechanika.pdf.

[5] W. Salejda, R. Poprawski, J. Misiewicz, L. Jacak, *Fizyka dla wyższych szkół technicznych*, Wrocław 2001; dostępny jest obecnie rozdział *Termodynamika* pod adresem: http://www.if.pwr.wroc.pl/dokumenty/podreczniki_elektroniczne/termodynamika.pdf

[6] Witryna dydaktyczna Instytutu Fizyki PWr; http://www.if.pwr.wroc.pl/

SECONDARY LITERATURE (IN ENGLISH):

[1] H.D. Young, R.A. Freedman, SEAR'S AND ZEMANSKY'S UNIVERSITY PHYSICS WITH MODERN PHYSICS, Addison-Wesley Publishing Company, wyd. 12. z 2008 r.

[2] D.C. Giancoli, *Physics Principles with Applications*, 6th Ed., Addison-Wesley, 2005; *Physics: Principles with Applications with MasteringPhysics*, 6th Ed., Addison-Wesley 2009.

[3] R.A. Serway, *Physics for Scientists and Engineers with Modern Physics*, 8th Ed., Brooks/Cole, Belmont 2009; zapowiadane jest kolejne wydanie w styczniu 2013 r.

[4] P.A. Tipler, G. Mosca, *Physics for Scientists and Engineers*, Extended Version, W. H. Freeman 2007.Gene Mosca, *Physics for Scientists and Engineers*, Extended Version

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Physics 1**
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical and Power Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives***	Programme content***	Teaching tool number***
PEK_W01 PEK_W02 PEK_W03	K1ENG_W03	C1.1	Lec 1	1, 6, 6
PEK_W04	K1ENG_W03	C1.1	Lec 2	1, 2, 3, 5, 6, 7
PEK_W05	K1ENG_W03	C1.1	Lec 3, Lec 4	1, 2, 3, 5, 6, 7
PEK_W06	K1ENG_W03	C1.1	Lec 5	1, 2, 3, 5, 6, 7
PEK_W07	K1ENG_W03	C1.1	Lec 5	1, 2, 3, 5, 6, 7
PEK_W08	K1ENG_W03	C1.1	Lec 7	1, 2, 3, 5, 6, 7
PEK_W09	K1ENG_W03	C1.1	Lec 8	1, 2, 3, 5, 6, 7
PEK_W10	K1ENG_W03 K1ENG_W10	C1.1	*Self-study*	7
PEK_W11	K1ENG_W03 K1ENG_W10	C1.1	Lec 12	1, 2, 3, 5, 6, 7
PEK_W12	K1ENG_W03	C1.2	Lec 9, Lec 10	1, 2, 3, 5, 6, 7
PEK_W13 PEK_W14	K1ENG_W03	C1.2	Lec 11	1, 2, 3, 5, 6, 7
PEK_W15 PEK_W16	K1ENG_W03 K1ENG_W11	C1.3	Lec 13, Lec 14	1, 2, 3, 5, 6, 7
PEK_W17	K1ENG_W03 K1ENG_W11	C1.3	Lec 15	1, 2, 3, 5, 6, 7
PEK_U01 PEK_U02	K1ENG_U10	C2.1	Lec 1-Lec 15	1, 2, 3, 5, 6, 7
PEK_U03	K1ENG_U10	C2.1	Lec 2	1, 2, 3, 5, 6, 7
PEK_U04 PEK_U05	K1ENG_U10	C2.1	Lec 2	1, 2, 3, 5, 6, 7
PEK_U06 PEK_U07	K1ENG_U10	C2.1	Lec 3	1, 2, 3, 5, 6, 7
PEK_U08	K1ENG_U10	C2.1	Lec 4	1, 2, 3, 5, 6, 7
PEK_U09	K1ENG_U10	C2.1	Lec 5	1, 2, 3, 5, 6, 7

PEK_U10 PEK_U11	K1ENG_U10	C2.1	Lec 5	1, 2, 3, 5, 6, 7
PEK_U12 PEK_U13 PEK_U14	K1ENG_U10	C2.1	Lec 7	1, 2, 3, 5, 6, 7
PEK_U15	K1ENG_U10	C2.1	Lec 8	1, 2, 3, 5, 6, 7
PEK_U16	K1ENG_U10 K1ENG_U15 K1ENG_U16	C2.1	Lec 12	1, 2, 3, 5, 6, 7
PEK_U17	K1ENG_U10	C2.2	Lec 9, Lec 10	1, 2, 3, 5, 6, 7
PEK_U18 PEK_U19	K1ENG_U10	C2.2	Lec 11	1, 2, 3, 5, 6, 7
PEK_U20 PEK_U21 PEK_U22	K1ENG_U10 K1ENG_U17 K1ENG_U18	C2.3	Lec 13- Lec 15	1, 2, 3, 5, 6, 7
PEK_K01÷ PEK_K08	K1ENG_K01	C3	Lec1÷Lec15	1, 2, 3, 5, 6, 7

** - enter symbols for main-field-of-study/specialization educational effects
*** - from table above