



# UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche		
ACADEMIC YEAR	2022/2023		
BACHELOR'S DEGREE (BSC)	BIOLOGICAL SCIENCES		
INTEGRATED COURSE	PHYSICS AND CHEMICAL PHYSICS WITH PRACTICE		
CODE	19762		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	FIS/07, CHIM/02		
HEAD PROFESSOR(S)	SALADINO MARIA LUISA Professore Associato Univ. di PALERMO AGLIOLO GALLITTO Professore Associato Univ. di PALERMO AURELIO		
OTHER PROFESSOR(S)	SALADINO MARIA LUISA Professore Associato Univ. di PALERMO MICELI MARCO Professore Associato Univ. di PALERMO AGLIOLO GALLITTO Professore Associato Univ. di PALERMO AURELIO LOMBARDO RENATO Ricercatore Univ. di PALERMO		
CREDITS	9		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	<b>AGLIOLO GALLITTO AURELIO</b> Tuesday 14:00 16:00 Via Archirafi 36, studio del docente (per gli studenti di Scienze Fisiche). Viale delle Scienze, Ed.18 (per gli studenti di Ottica e Optometria e gli studenti di Scienze Biologiche). Modalità a distanza. Su appuntamento. Thursday 14:00 16:00 Via Archirafi 36, studio del docente (per gli studenti di Scienze Fisiche). Viale delle Scienze, Ed.18 (per gli studenti di Ottica e Optometria e gli studenti di Scienze Biologiche). Modalità a distanza. Su appuntamento. <b>LOMBARDO RENATO</b> Tuesday 10:00 12:00 Dipartimento STEBICEF Studio 1/B4, edificio 17, viale delle Scienze Thursday 10:00 12:00 Dipartimento STEBICEF Studio 1/B4, edificio 17, viale delle Scienze <b>MICELI MARCO</b> Wednesday 14:30 16:30 Dipartimento di Fisica e Chimica, via Archirafi 36 (con prenotazione via email) Thursday 14:30 16:30 Dipartimento di Fisica e Chimica, via Archirafi 36 (con prenotazione via email) <b>SALADINO MARIA LUISA</b> Monday 14:00 16:00 Dipartimento STEBICEF, Edificio 17, piano I Wednesday 14:00 16:00 Dipartimento STEBICEF, Edificio 17, piano I Thursday 14:00 16:00 Dipartimento STEBICEF, Edificio 17, piano I		

<b>PREREQUISITES</b>	Prerequisites are the topics of Maths, Physics and Chemistry requested to access the Course. Attendance of first semester subject of Maths and General Chemistry are necessary to fully achieve the learning outcomes.
<b>LEARNING OUTCOMES</b>	<p>Knowledge and understanding. Knowledge of the basic concepts of classical physics and physical chemistry. Knowledge of the scientific method.</p> <p>Applying knowledge and understanding. Students become capable of solving simple problems of classical physics and physical chemistry as samples of rigorous application of the scientific method.</p> <p>Making judgements. Students are able of autonomous choice of laws and solving method for simple problem of classical physics and physical chemistry. They are able to evaluate energy balance and mechanism of simple chemical reactions and biological processes.</p> <p>Communication. Students are able of explain clearly and concisely the fundamental laws of classical physics and physical chemistry.</p> <p>Lifelong learning skills. Students are able of understand and deepen the grounds of classical physics and physical chemistry. They are able of understand the physical bases of the operation of instrumentation used in biological and biomedical laboratories.</p>
<b>ASSESSMENT METHODS</b>	<p>The ongoing test is a self-assessment test (not mandatory) and will not be taken into consideration for the evaluation of the final exams.</p> <p>Final assessment consists of an oral examination preceded, for each scheduled exam, by written resolution of simple Physics and Physical-Chemistry questions and/or exercises.</p> <p>The written resolution of exercises or tests will be held at the time and place published for every scheduled exam. The written resolution of exercises consists of doing, without the aid of textbooks or notes, basic exercises that involve the main laws of mechanics, fluids, classical thermodynamics, electromagnetism and physical-chemistry. Samples of such exercise are in the textbooks and also available online on the web sites of both modules. The written test is passed if the candidate exceeds a minimum threshold for both modules. The written resolution of problems is done to check, at equal conditions for all candidates, the degree of knowledge of the subjects of the course and the ability to use them in simple situations.</p> <p>Scheduling of the oral test will be announced during the written exam. The oral test consists of an examination-interview concerning discussion of the exercises, with particular reference to the mistakes and the shortcomings highlighted in the resolution of exercises, and knowledge of topics of the syllabus. This test is done to evaluate also the scientific language skills of the student and his ability of clear and direct wording.</p> <p>The final assessment, properly graded, will be drawn on the basis of the following conditions:</p> <p>a) basic knowledge of the topics studied, limited language skills (18-21 rating);</p> <p>b) good knowledge of the topics studied and sufficient ability to apply the laws in simple situations, even in a guided way, sufficient presentation and language skills (22-25 rating);</p> <p>c) In-depth knowledge of the topics studied and good ability to apply the laws in simple situations autonomously, good language skills (26-28 rating);</p> <p>d) In-depth knowledge of the topics studied and good ability to apply the laws to new situations autonomously, excellent language and communication skills (29-30L rating).</p>
<b>TEACHING METHODS</b>	<p>The whole subject is scheduled on second semester of the first year and contains two subject: Physics and Physical-Chemistry. Students have to attend frontal teaching during which the course subjects are introduced and simple exercises are resolved.</p> <p>A break is done at half of the semester to do an ongoing evaluation (not mandatory) on mechanics, fluids and thermodynamics, which will be assessed as described in the "Assessment methods" section. Only Physics lectures are done before break. Chemical-Physics lectures start after the break.</p>

<b>PREREQUISITES</b>	Prerequisites are the topics of Maths, Physics and Chemistry requested to access the Course. Attendance of first semester subject of Maths and General Chemistry are necessary to fully achieve the learning outcomes.
<b>LEARNING OUTCOMES</b>	<p>Knowledge and understanding.</p> <p>Knowledge of the basic concepts of classical physics and physical chemistry.</p> <p>Knowledge of the scientific method.</p> <p>Applying knowledge and understanding.</p> <p>Students become capable of solving simple problems of classical physics and physical chemistry as samples of rigorous application of the scientific method.</p> <p>Making judgements. Students are able of autonomous choice of laws and solving method for simple problem of classical physics and physical chemistry. They are able to evaluate energy balance and mechanism of simple chemical reactions and biological processes.</p> <p>Communication. Students are able of explain clearly and concisely the fundamental laws of classical physics and physical chemistry.</p> <p>Lifelong learning skills. Students are able of understand and deepen the grounds of classical physics and physical chemistry. They are able of understand the physical bases of the operation of instrumentation used in biological and biomedical laboratories.</p>
<b>ASSESSMENT METHODS</b>	<p>The ongoing test is a self-assessment test (not mandatory) and will not be taken into consideration for the evaluation of the final exams.</p> <p>Final assessment consists of an oral examination preceded, for each scheduled exam, by written resolution of simple Physics and Physical-Chemistry exercises. The written resolution of exercises or tests will be held at the time and place published for every scheduled exam. The written resolution of exercises consists of doing, without the aid of textbooks or notes, basic exercises that involve the main laws of mechanics, fluids, classical thermodynamics, electromagnetism and physical-chemistry. Samples of such exercise are in the textbooks and also available online on the web sites of both modules. The written test is passed if the candidate exceeds a minimum threshold for both modules. The written resolution of problems is done to check, at equal conditions for all candidates, the degree of knowledge of the subjects of the course and the ability to use them in simple situations.</p> <p>Scheduling of the oral test will be announced during the written exam. The oral test consists of an examination-interview concerning discussion of the exercises, with particular reference to the mistakes and the shortcomings highlighted in the resolution of exercises, and knowledge of topics of the syllabus. This test is done to evaluate also the scientific language skills of student and his ability of clear and direct wording.</p> <p>The final assessment, properly graded, will be drawn on the basis of the following conditions:</p> <p>a) basic knowledge of the topics studied, limited language skills (18-21 rating);</p> <p>b) good knowledge of the topics studied and sufficient ability to apply the laws in simple situations, even in a guided way, sufficient presentation and language skills (22-25 rating);</p> <p>c) In-depth knowledge of the topics studied and good ability to apply the laws in simple situations autonomously, good language skills (26-28 rating);</p> <p>d) In-depth knowledge of the topics studied and good ability to apply the laws to new situations autonomously, excellent language and communication skills (29-30L rating).</p>
<b>TEACHING METHODS</b>	<p>The whole subject is scheduled on second semester of the first year and contains two subject: Physics and Physical-Chemistry. Students have to attend frontal teaching during which the course subjects are introduced and simple exercises are resolved.</p> <p>A break is done at half of the semester to do an ongoing evaluation (not mandatory) on mechanics, fluids and thermodynamics, which will be assessed as described in the "Assessment methods" section. Only Physics lectures are done before break. Chemical-Physics lectures start after the break.</p>

## MODULE PHYSICS WITH PRACTICE

*Prof. AURELIO AGLIOLO GALLITTO - Lettere L-Z, - Lettere L-Z*

### SUGGESTED BIBLIOGRAPHY

Testo base: R.A. Serway, J. W. Jewett Jr, Fondamenti di Fisica, VI Ed., Edises 2022, ISBN: 978-8836230730 o altre edizioni  
Basic textbook: R.A. Serway, J. W. Jewett Jr, Physics for Scientists and Engineers, 10th Ed. Cengage 2017. ISBN: 978-1337553292 or other editions.

Testo di consultazione: R.C. Davidson, Metodi Matematici per un Corso Introduttivo di Fisica, Edises, ISBN: 978-88-7959-763-0

Supplementary textbook: R.C. Davidson, Mathematical Methods for Introductory Physics With Calculus, III Ed. Saunders College Pub. 1994, ISBN: 978-0030091285

Testo di consultazione/supplementary textbook: A. Bartolotta, Meccanica dei Fluidi, Edises, ISBN: 978-88-7959-875-0

Il materiale didattico relativo al modulo, curato dal docente, è consultabile al seguente link/The teaching material, edited by the teacher, is available on the following web page: <https://sites.google.com/site/aurelioagliologallitto/didattica/fisica>

<b>AMBIT</b>	50025-Discipline matematiche, fisiche e informatiche
<b>INDIVIDUAL STUDY (Hrs)</b>	98
<b>COURSE ACTIVITY (Hrs)</b>	52

### EDUCATIONAL OBJECTIVES OF THE MODULE

The subject is devoted to acquire basic knowledge of classical physics, also by resolving simple problems and exercises.

## SYLLABUS

Hrs	Frontal teaching
6	Physical quantities, units of measurement, errors, plots. Vectors. Kinematics of a particle in one, two and three dimensions. Motion with constant velocity, motion with constant acceleration, uniform circular motion. Basic elements of rotational kinematics.
6	Dynamics of a particle: Newton's laws of motion. Gravitational force, normal force, frictional forces, centripetal force, tension, elastic spring forces. Torque. Basic elements of rotational dynamics.
6	Kinetic energy. Work-energy theorem. Conservative and non-conservative forces. Gravitational potential energy. Conservation of mechanical energy. Momentum. Conservation of momentum. Center of mass. Elastic and inelastic collisions. Simple harmonic oscillator.
6	Fluid statics: pressure, laws of Pascal and Stevin, Archimedes' principle. Fluid hydrodynamics: flow of an ideal fluid, equation of continuity, Bernoulli's equation. Elements of viscous fluids, sedimentation and surface tension.
6	Thermodynamics. Thermal equilibrium. Temperature scales. Thermal expansion. Heat capacity and specific heat. The ideal gas law. Kinetic theory of gases. The first law of thermodynamics. Internal energy of an ideal gas. Reversible and irreversible thermodynamic transformations. Thermodynamic cycles. Performance of a thermal engine. The second law of thermodynamics and entropy.
10	Electric charge, conductors and insulators, Coulomb's force, superposition principle. Electrostatic field. Electric dipole. Electrostatic potential energy, electrostatic potential. Capacitor. Electric current. Ohm's law. DC circuits. Lorentz's force. Magnetic field. Faraday induction. Electromagnetic waves. Introduction to the interaction of electromagnetic waves with biological matter.
Hrs	Practice
12	Recalls of the basic elements of mathematics necessary for the topics of the lectures. Exercises for the preparation for the in itinere test and the exam. It is expected 2 hours for each of the arguments specified in the lectures.

## MODULE PHYSICS WITH PRACTICE

*Prof. MARCO MICELI - Lettere A-K, - Lettere A-K*

### SUGGESTED BIBLIOGRAPHY

- Serway-Jewett, Fondamenti di Fisica, VI Ed., Edises ISBN 978 88 3623 073 0  
 - R.A. Serway, J. W. Jewett Jr, Principi di Fisica, V Ed., Edises ISBN 9788879598644  
 - David Halliday, Robert Resnick Jearl Walker, Fondamenti di Fisica - volume unico, Casa Editrice Ambrosiana, ISBN 978-88-08-18229-6

<b>AMBIT</b>	50025-Discipline matematiche, fisiche e informatiche
<b>INDIVIDUAL STUDY (Hrs)</b>	98
<b>COURSE ACTIVITY (Hrs)</b>	52

### EDUCATIONAL OBJECTIVES OF THE MODULE

Strong general knowledge of classical physics (mechanics, fluid dynamics, thermodynamics, electromagnetism); expertise on the scientific method; capability to solve and discuss simple problems of classical physics.

## SYLLABUS

Hrs	Frontal teaching
6	Physical quantities, definition and measures. Scalars and vectors. Particle kinematics
6	Newton's laws and particle mechanics. Inertial and non-inertial systems. Friction. Newton's law of universal gravitation.
6	Kinetic energy. Work. Conservative forces and potential energy. Mechanical energy conservation. Momentum and its conservation Collisions
6	Hydrostatics. Stevin and Pascal laws. Archimedes' principle. Hydrodynamics. Continuity equation and Bernoulli's law. Viscosity
8	Thermodynamics. Zero-th principle. Thermometry and calorimetry. Heat capacity and specific heat capacity. Ideal Gas. First law of thermodynamics. Kinetic theory of ideal gas. Internal energy of an ideal gas. Energia interna di un gas ideale. Reversible and irreversible thermodynamic processes. Thermodynamic cycles and thermal efficiency. Second law of thermodynamics and entropy
8	Electric charge. Coulomb's law. Superposition principle. Electric field. Electrostatic potential. Electric current. Ohm's law. Magnetic field. Lorentz force. General notes on electromagnetic waves and their interaction with biological systems
Hrs	Practice
12	Exercises and problem solving (approx. 2 hours for each of the aforementioned items)

## MODULE PHYSICAL CHEMISTRY

*Prof. RENATO LOMBARDO - Lettere L-Z, - Lettere L-Z*

### SUGGESTED BIBLIOGRAPHY

Atkins, P.W.; De Paula, Elementi di Chimica Fisica, Zanichelli, 2018, ISBN 9788808220684

Atkins, P.W.; De Paula, J. Elements of Physical Chemistry, Oxford University Press, 2017, ISBN 9780198727873

<b>AMBIT</b>	10665-Attività formative affini o integrative
<b>INDIVIDUAL STUDY (Hrs)</b>	51
<b>COURSE ACTIVITY (Hrs)</b>	24

### EDUCATIONAL OBJECTIVES OF THE MODULE

Provide cultural tools to link atomic-molecular vision to macroscopic vision and understand Biomolecular phenomena in the light of energy based on thermodynamic principles.

## SYLLABUS

Hrs	Frontal teaching
4	Matter at the atomic scale and intermolecular interactions: phenomena and applications. Microscopic structure of matter. Macroscopic-microscopic correlation. Aggregation states. Microscopic interpretation of state transitions. Intermolecular potential. Attractive and repulsive contribution. Scale of interactions. Lennard-Jones Potential. Hydrogen bond.
3	First law of thermodynamics. System and surroundings. System Classification: Open, Closed, Isolated and Adiabatic. Internal energy. Energy transfer between system and surroundings. Work and heat. Enthalpy. Termochemical. Hess's law. Kirchoff's Law.
5	Second law of thermodynamics. Statistical Entropy. Spontaneous and non-spontaneous transformations and equilibrium. The Third Principle of thermodynamics. Second law enunciates. Gibbs Free Energy. Free energy variation for physical processes and chemical reactions. Equilibrium Reactions. Thermodynamic constant of equilibrium. Effect of temperature and pressure.
4	Physical transformations. Thermodynamically stable phases. Chemical potential. Phase Diagram: Definition, identification of characteristic points and phase boundaries. Phase boundaries. Thermodynamic derivation of phase boundaries. The rule of phases. The phase diagram of water, carbon dioxide and helium.
4	Multiple components systems Mixtures and solutions. Solution Properties. Non-electrolytic solutions. Raoult Law. Colligative properties: freezing point depression, boiling point elevation, osmotic pressure.
4	Rate and mechanism of chemical and biochemical reactions Dependence of properties on concentration. Measurement of concentration as function of time. Instant rate. Kinetic law, kinetic constant and reaction order. The method of insulation. The method of initial rates and integrated rates. The chemical equilibrium from the kinetic point of view. Dependence of kinetic constant on temperature: Arrhenius law. Activation energy.

**MODULE  
PHYSICAL CHEMISTRY**

*Prof.ssa MARIA LUISA SALADINO - Lettere A-K, - Lettere A-K*

**SUGGESTED BIBLIOGRAPHY**

Atkins, P.W.; De Paula, J. Physical Chemistry for the Life Sciences, Oxford University Press, 2011. ISBN: 9780199564286  
 Atkins, P. W.; De Paula, J. Chimica fisica biologica: 1; Zanichelli: Bologna, 2008. ISBN: 9788808068019  
 Atkins, P.W.; De Paula, J. Elementi di Chimica Fisica, Zanichelli: Bologna, 2018. ISBN: 9788808220684  
 Atkins, P.W.; De Paula, J., Keeler J., Chimica fisica, Zanichelli: Bologna, 2020. ISBN: 9788808620521

<b>AMBIT</b>	10665-Attività formative affini o integrative
<b>INDIVIDUAL STUDY (Hrs)</b>	51
<b>COURSE ACTIVITY (Hrs)</b>	24

**EDUCATIONAL OBJECTIVES OF THE MODULE**

To provide the cultural tools to connect the atomic-molecular vision with that at the macroscopic level and to interpret biomolecular phenomena in terms of energy by means of thermodynamic principles.

**SYLLABUS**

Hrs	Frontal teaching
4	Matter at the atomic scale and intermolecular interactions: phenomena and applications Structure of the matter at microscopic level. Correlation of macroscopic evidences on the basis of microscopic model. States of aggregation. Microscopic interpretation of state transitions. Interaction potentials. On the nature of attractive and repulsive contributions to the total interaction. Scale of interaction strength. Lennard-Jones potential. Hydrogen bond.
3	First law of thermodynamics. System and surroundings. Open, closed, insulated and adiabatic systems. Internal energy. Transfers of energy from system to surrounding. Heat and work. Enthalpy. Thermochemistry. Hess law. Kirchoff law.
5	Second law of thermodynamics Statistical entropy. Spontaneous, non-spontaneous and equilibrium processes. Third law of thermodynamics. Gibbs free energy. Free energy of physical processes and chemical reactions. Equilibrium reactions. Thermodynamics constant of equilibrium. Dependency from temperature and pressure.
4	Physical transformations. Thermodynamics phases. Chemical potential. Phase diagram: phase boundaries, triple and critical points. Derivation of phase boundaries on thermodynamics basis. Gibbs phase rule. Water, carbon dioxide phase diagrams.
4	Multiple components systems. Mixtures and solutions. Solution properties. Partial molar properties. Non electrolytic solutions. Raoult's law. Colligative properties: Boiling and freezing point, osmotic pressure
4	Rate and mechanism of chemical and biochemical reactions Physical property-concentration dependency. Measure of concentration as a function of time. Instantaneous speed. The rate laws, kinetics constant and order of reactions. Methods of evaluation of order of reactions. Kinetics approach to the chemical equilibrium. Kinetics constant: effect of temperature, the Arrhenius law. Activation energy.