



# UNIVERSITÀ DEGLI STUDI DI PALERMO

<b>DEPARTMENT</b>	Biomedicina, Neuroscienze e Diagnostica avanzata		
<b>ACADEMIC YEAR</b>	2016/2017		
<b>MASTER'S DEGREE (MSC)</b>	MEDICINE AND SURGERY		
<b>INTEGRATED COURSE</b>	CHEMISTRY AND BIOCHEMISTRY - INTEGRATED COURSE		
<b>CODE</b>	17447		
<b>MODULES</b>	Yes		
<b>NUMBER OF MODULES</b>	2		
<b>SCIENTIFIC SECTOR(S)</b>	BIO/10		
<b>HEAD PROFESSOR(S)</b>	LAURICELLA MARIANNA Professore Ordinario	Univ. di PALERMO	
	DI GAUDIO FRANCESCA Ricercatore	Univ. di PALERMO	
	DI LIEGRO ITALIA Professore a contratto in quiescenza	Univ. di PALERMO	
<b>OTHER PROFESSOR(S)</b>	LAURICELLA MARIANNA Professore Ordinario	Univ. di PALERMO	
	EMANUELE SONIA Professore Associato	Univ. di PALERMO	
	DI LIEGRO ITALIA Professore a contratto in quiescenza	Univ. di PALERMO	
	DI GAUDIO FRANCESCA Ricercatore	Univ. di PALERMO	
	BUTERA DANIELA Ricercatore	Univ. di PALERMO	
<b>CREDITS</b>	12		
<b>PROPAEDEUTICAL SUBJECTS</b>			
<b>MUTUALIZATION</b>			
<b>YEAR</b>	1		
<b>TERM (SEMESTER)</b>	1° semester		
<b>ATTENDANCE</b>	Mandatory		
<b>EVALUATION</b>	Out of 30		
<b>TEACHER OFFICE HOURS</b>	<p><b>BUTERA DANIELA</b> Monday 09:00 11:00 da concordare previo appuntamento via mail</p> <p><b>DI GAUDIO FRANCESCA</b> Friday 13:00 14:00 DIPARTIMENTO PROMOZIONE DELLA SALUTE, MATERNO INFANTILE DI MEDICINA INTERNA E SPECIALISTICA DI ECCELLENZA - PROMISE - "GIUSEPPE D'ALESSANDRO" - CQRC Via del Vespro n. 133, primo piano</p> <p><b>DI LIEGRO ITALIA</b> Monday 10:00 12:00 Caltanissetta, CEFPAS, padiglione 3, o Palazzo Moncada. Wednesday 15:00 17:00 Palermo, Viale delle Scienze, Edificio 16 (STEBICEF) Thursday 15:00 17:00 Palermo, Viale delle Scienze, Edificio 16 (STEBICEF) Friday 15:00 17:00 Palermo, Viale delle Scienze, Edificio 16 (STEBICEF)</p> <p><b>EMANUELE SONIA</b> Thursday 11:00 13:00 Sezione di Biochimica, Dipartimento BioNeC, Policlinico, via del Vespro 129 90127 Palermo</p> <p><b>LAURICELLA MARIANNA</b> Monday 9:00 11:00 SEzione di Biochimica del BIND</p>		

<p><b>PREREQUISITES</b></p>	<p>The prerequisites are those established at the national level to access to the degree course in Medicine and Surgery. In order to be admitted to this course, indeed, these students must pass a mandatory competition based on tests that include questions on basic chemistry and biochemistry.</p>
<p><b>LEARNING OUTCOMES</b></p>	<p>Knowledge and Capacity of understanding: The students should know and understand: i) the basic atomic, molecular, and physicochemical properties of matter, ii) the characteristics of the elements and molecules and the principles which underlie their chemical and physical behavior; iii) the structures and properties of the main organic compounds and biological macromolecules. The students should also know the biochemical and molecular bases of cellular activities and understand the mechanisms that regulate the metabolic processes. In particular, they should know: i) the main biological molecules and the metabolic processes in which they are involved; ii) the mode of action of enzymes, and the principles of enzyme catalysis and regulation; iii) the bases of bioenergetics and iv) the general mechanisms of extracellular signal transduction.</p> <p>Capacity to apply knowledge and understanding: The students should be able to apply their knowledge for interpreting the behavior of biological molecules and understanding the molecular mechanisms which underlie the metabolic processes and life.</p> <p>Making judgments: The students should acquire autonomy in the learning process in order to become able to evaluate possible interactions among the different metabolic processes and xenobiotics.</p> <p>Communication skills: The students should be able to express the basics of acquired knowledge by both written and oral essays, with scientific-technical language appropriate to the topics discussed.</p> <p>Learning ability: The students should develop a scientific learning methodology which allows them to interpret and further investigate the biochemical problems arising in the continuation of their studies and career; they should acquire the ability to integrate all the acquired knowledge by also showing a critical approach to biological problems and an attitude towards the scientific research. Finally, they should be able to propose solutions for analytical problems, and to search autonomously for updated scientific information.</p>
<p><b>ASSESSMENT METHODS</b></p>	<p>Since the two modules (6 CFU for Chemistry and 6 CFU for Biochemistry) of C.I. 17447 are held respectively in the first and second semester of the first year, the assessment of current students, during the course of C.I. and therefore until the end of the second semester classes, it will be made through an interim Chemical proof that will consist of a written test alleging Acid-base homeostasis, osmotic, solubility and oxidation reduction and an oral exam on all the topics of Module. Overcoming this intermediate test will allow students to have a bonus for the final exam of C.I. which will be valid for one year (365 days).</p> <p>From the first call useful following the end of the second semester classes the students of the first year will be evaluated with an oral test on joint topics entire C.I. possibly preceded by a two written tests of Chemistry and Biochemistry of a. The written exam will be on Chemistry Acid-base homeostasis, osmotic, solubility and oxidation reduction, while that of Biochemistry of about 30 questions of Biochemistry multiple choice throughout the Biochemistry of the module program.</p> <p>Students of the following years and not being always carry out the examination in an integrated manner, ie, via the oral test on joint topics entire C.I. , Possibly preceded by a two written tests of Chemistry and Biochemistry of a. The written exam will be on Chemistry Acid-base homeostasis, osmotic, solubility and oxidation reduction, while that of Biochemistry of about 30 questions of Biochemistry multiple choice throughout the Biochemistry of the module program. The two written tests are held on different days and before the final integrated oral examination.</p> <p>Each interview is aimed to assess both knowledge and full understanding of the topics addressed in the course , as well as the candidate personal capacity of explain and processing his/her knowledge. Attribution of the mark is done according to the criteria approved by the Council of the School of Medicine and summarized in the table published in the School web site. In order to pass the exam the candidate has to be evaluated with a final mark between 18 and 30 cum laude.</p>
<p><b>TEACHING METHODS</b></p>	<p>Frontal lectures, written tutorials, visit the center of Mass Spectrometry - Center for Quality Control and Chemical Risk (CQRC).</p>

<p><b>PREREQUISITES</b></p>	<p>The prerequisites are those established at the national level to access to the degree course in Medicine and Surgery. In order to be admitted to this course, indeed, these students must pass a mandatory exam based on tests that include questions on basic and organic chemistry.</p> <p>In detail, the exam program (DM July 3, 2015 n. 463, Annex A) requires a basic knowledge on the following topics:</p> <p>The constitution of matter: the states of matter; heterogeneous and homogeneous systems; compounds and elements. Ideal Gas Laws. Atomic structure: elementary particles; atomic number and mass number, isotopes, electronic structure of atoms of the various elements. The periodic table of the elements: groups and periods; transition elements. Periodic properties of the elements: atomic radius, ionization potential, electron affinity, metallic character. Relations between electronic structure, position in the periodic table and properties of the elements. Chemical bonds: ionic, covalent and metallic. Binding energy. Polarity of bonds. Electronegativity. Intermolecular bonds. Fundamentals of inorganic chemistry: nomenclature and main properties of inorganic compounds: oxides, hydroxides, acids, salts. The chemical reactions and the stoichiometry: atomic and molecular mass, Avogadro's number, concept of mole and its application, elementary stoichiometric calculations, balancing of simple reactions, types of chemical reaction. The solutions: properties of solvents, solubility, main ways of expressing solution concentration. Equilibria in aqueous solution. Basics of chemical kinetics and catalysis. Oxidation and reduction: oxidation number. Balancing simple reactions. Acids and bases: basic concepts. Acidity, neutrality and basicity of the aqueous solutions. The pH. Hydrolysis. Buffer solutions. Fundamentals of organic chemistry: bonds between carbon atoms, structure formulas; concept of isomerism. Aliphatic, alicyclic and aromatic compounds. Functional groups: alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, amides. Basic elements of nomenclature in organic chemistry.</p>
<p><b>LEARNING OUTCOMES</b></p>	<p>Knowledge and understanding: The students should know and understand: i) the basic atomic, molecular, and physicochemical properties of matter, ii) the characteristics of the elements and molecules and the principles which underlie their chemical and physical behavior; iii) the structures and properties of the main organic compounds and biological macromolecules. The students should also know the biochemical and molecular bases of cellular activities and understand the mechanisms that regulate the metabolic processes. In particular, they should know: i) the main biological molecules and the metabolic processes in which they are involved; ii) the mode of action of enzymes, and the principles of enzyme catalysis and regulation; iii) the bases of bioenergetics and iv) the general mechanisms of extracellular signal transduction.</p> <p>Applying knowledge and understanding: The students should be able to apply their knowledge for interpreting the behavior of biological molecules and understanding the molecular mechanisms which underlie the metabolic processes and life.</p> <p>Making judgements: The students should acquire autonomy in the learning process in order to become able to evaluate possible interactions among the different metabolic processes and xenobiotics.</p> <p>Communication ability: The students should be able to express the basics of acquired knowledge by both written and oral essays, with scientific-technical language appropriate to the topics discussed.</p> <p>Lifelong learning skills: The students should develop a scientific learning methodology which allows them to interpret and further investigate the biochemical problems arising in the continuation of their studies and career; they should acquire the ability to integrate all the acquired knowledge by also showing a critical approach to biological problems and an attitude towards the scientific research. Finally, they should be able to propose solutions for analytical problems, and to search autonomously for updated scientific information.</p>
<p><b>ASSESSMENT METHODS</b></p>	<p>The evaluation consists of two written tests (one on chemistry and one on biochemistry) and an oral final test consisting of an interview aimed at verifying theoretic knowledge and full understanding of the topics addressed in the course, as well as the candidate personal capacity of explain and processing his/her knowledge. Attribution of the mark is done according to the criteria approved by the Council of the School of Medicine and summarized in the table published in the School web site. In order to pass the exam the candidate has to be evaluated with a final mark between 18 and 30.</p> <p>The two written tests are held on different days and before the final integrated</p>

	<p>oral examination.</p> <p>In particular, the written test on chemistry consists of 5 exercises on quantitative chemistry, focused on the oxidation-reduction reactions, chemical equilibria and buffer systems.</p> <p>The written test on biochemistry consists of 31 multiple-choice questions which may include a part in which the student is required to briefly explain the reasons for the choice made.</p>
<b>TEACHING METHODS</b>	Frontal lectures and written exercises.

**DOCENTE:** Prof.ssa MARIANNA LAURICELLA- Sede IPPOCRATE

<b>PREREQUISITES</b>	The prerequisites are those established at the national level to access to the degree course in Medicine and Surgery. In order to be admitted to this course, indeed, these students must pass a mandatory competition based on tests that include questions on basic chemistry and biochemistry.
<b>LEARNING OUTCOMES</b>	<p>The students should know and understand: i) the basic atomic, molecular, and physicochemical properties of matter, ii) the characteristics of the elements and molecules and the principles which underlie their chemical and physical behavior; iii) the structures and properties of the main organic compounds and biological macromolecules. The students should also know the biochemical and molecular bases of cellular activities and understand the mechanisms that regulate the metabolic processes. In particular, they should know: i) the main biological molecules and the metabolic processes in which they are involved; ii) the mode of action of enzymes, and the principles of enzyme catalysis and regulation; iii) the bases of bioenergetics and iv) the general mechanisms of extracellular signal transduction.</p> <p>The students should be able to apply their knowledge for interpreting the behavior of biological molecules and understanding the molecular mechanisms which underlie the metabolic processes and life.</p> <p>The students should acquire autonomy in the learning process in order to become able to evaluate possible interactions among the different metabolic processes and xenobiotics.</p> <p>The students should be able to express the basics of acquired knowledge by both written and oral essays, with scientific-technical language appropriate to the topics discussed.</p> <p>The students should develop a scientific learning methodology which allows them to interpret and further investigate the biochemical problems arising in the continuation of their studies and career; they should acquire the ability to integrate all the acquired knowledge by also showing a critical approach to biological problems and an attitude towards the scientific research. Finally, they should be able to propose solutions for analytical problems, and to search autonomously for updated scientific information.</p>
<b>ASSESSMENT METHODS</b>	<p>The evaluation consists of two written tests (one on chemistry and one on biochemistry) and an oral final test consisting of an interview aimed at verifying theoretic knowledge and full understanding of the topics addressed in the course, as well as the candidate personal capacity of explain and processing his/ her knowledge. Attribution of the mark is done according to the criteria approved by the Council of the School of Medicine and summarized in the table published in the School web site (<a href="http://www.unipa.it/scuole/dimedicinaechirurgia">http://www.unipa.it/scuole/dimedicinaechirurgia</a>). In order to pass the exam the candidate has to be evaluated with a final mark between 18 and 30.</p> <p>The two written tests are held on different days and before the final integrated oral examination.</p> <p>In particular, the written test on chemistry consists of 5 exercises on quantitative chemistry, focused on the oxidation-reduction reactions, chemical equilibria and buffer systems.</p> <p>The written test on biochemistry consists of 30 multiple-choice questions which includes a part in which the student is required to briefly explain the reasons for the choice made.</p>
<b>TEACHING METHODS</b>	Frontal lectures

**MODULE**  
**CHEMISTRY AND INTRODUCTORY BIOCHEMISTRY**

*Prof.ssa DANIELA BUTERA - Sede IPPOCRATE, - Sede IPPOCRATE*

**SUGGESTED BIBLIOGRAPHY**

PROIEZIONI IN POWER POINT fornite dal docente

TESTI:

Whitten

Chimica

Piccin

Kotz e Purcell Chimica Edises

**AMBIT**

50423-Struttura, funzione e metabolismo delle molecole d'interesse biologico

**INDIVIDUAL STUDY (Hrs)**

90

**COURSE ACTIVITY (Hrs)**

60

**EDUCATIONAL OBJECTIVES OF THE MODULE**

To supply to the student the basic knowledges of general chemistry and the necessary instruments to being able to comprise the properties of organic compounds and the macromolecules of biological interest.

**SYLLABUS**

Hrs	Frontal teaching
2	Calculations and measurements: Introduction, scientific method, Materia, measuring systems, main unit of measurement, accuracy, precision, Errors, significant expressions and scientific notations, significant digits in calculations.
4	Atoms and molecules: Introduction, periodic table, electron configurations, energy levels and Sublevels, octet rule, orbital, electronic filling, periodic properties.
2	INTERMOLECULAR FORCES: ionic compounds, Covalent compounds, Poliatomici Ions, Nomenclature, geometry of molecules, Polarity, types of forces that exist between the polar and Ionic compounds, hydrogen bond
3	Chemical reactions: Balancing equations, classification of chemical reactions, Redox Reactions, oxidation number and other classes of reactions, ionic Equations, weight, limiting Reagents.
3	STATES OF MATTER: Kinetic and Potential Energy, State Solid, Liquid State, Gaseous State, State changes
3	SOLUTIONS AND COLLOIDS: Solubility, Ways of expressing concentration, Stechiometry of solutions, Aqueous Solutions, colligative properties, Osmosis, Vapor Pressure, Colloids, Dialysis.
2	SPEED 'REACTION AND CHEMICAL BALANCE: Thermodynamics, kinetics, catalysis, chemical equilibrium, Le Chatelier's principle
3	ACID BASES AND SALTS: acid-base theories, acids and bases and their properties, Strength of acid-base equilibria, pH and pOH, salts and their hydrolysis, titration (notes), swabs and biological buffers.
2	NUCLEAR REACTIONS: Introduction, Main types of radiation, half-time, fission and fusion, the main uses of radioactive isotopes, Medical Applications, field radiative Security
1	ALKANES: Carbon, formulas, structures and isomers, Alkanes and Nomenclature Cycloalkanes, sources and reactions, halides alchilic
2	HYDROCARBONS UNSATURATED: Property, Alkenes and Nomenclature Alkanes and Nomenclature, geometric isomers, Reactions of Alkenes, aromatic hydrocarbons
18	ORGANIC COMPOUNDS AND BIOLOGICAL MOLECULES: Alcohols, phenols and ethers, aldehydes and ketones, carboxylic acids and their derivatives, esters and anhydrides of biological importance, amines and amides, Carbohydrates, Lipids, Proteins, Enzymes, Nucleic Acids, Nutrition and Energy for life , metabolism of carbohydrates, metabolism Lipids, Metabolism of Amino Acids, biological Fluids.
Hrs	Practice
5	ACID BASES AND SALTS: acid-base theories, acids and bases and their properties, Strength of acid-base equilibria, pH and pOH, salts and their hydrolysis, titration (notes), swabs and biological buffers

**MODULE**  
**CHEMISTRY AND INTRODUCTORY BIOCHEMISTRY**

*Prof.ssa FRANCESCA DI GAUDIO - Sede CHIRONE, - Sede CHIRONE*

**SUGGESTED BIBLIOGRAPHY**

CHIMICA E PROPEDEUTICA BIOCHIMICA con inclusi il kit di modellistica molecolare.

F. A. Bettelheim, W. H. Brown, M. K. Campbell, S. Farrell  
EDISES

STECIOMETRIA

P. Giannoccaro S. Doronzo  
EDISES

TESTI ALTERNATIVI:

CHIMICA ORGANICA

H. HART CHIMICA ORGANICA - ZANICHELLI

CHIMICA

KOTZ E PURCELL CHIMICA IV edizione 2009 - EDISES

STECIOMETRIA

G. ALONSO ESERCIZI DI CHIMICA EDIERMES non piu' in stampa

<b>AMBIT</b>	50423-Struttura, funzione e metabolismo delle molecole d'interesse biologico
<b>INDIVIDUAL STUDY (Hrs)</b>	90
<b>COURSE ACTIVITY (Hrs)</b>	60

**EDUCATIONAL OBJECTIVES OF THE MODULE**

Knowing the atomic and molecular basis of matter

Knowing the atomic and molecular basis of life processes

Know the characteristics of the elements and molecules present in biological systems and the underlying principles of their behavior in order to understand human metabolic processes

**SYLLABUS**

Hrs	Frontal teaching
2	CALCULATIONS AND MEASURES: Introduction, Scientific Method, Matter, Measurement Systems, Main units' measurement, Accuracy, Accuracy, Errors, significant expressions and notations Scientific, Significant Figures in Calculations.
4	ATOMS, MOLECULES AND ATOMIC MODELS: Introduction, Atomic Structure, Electronic Configurations, and energy levels Sublayers, octet rule, Electronic filling, Periodic Table, Orbital and MO theory, properties' periodical.
4	CHEMICAL BOND AND FORCES INTERMOLECULAR: the theory of the chemical bond, Covalent compounds, ionic compounds, polyatomic ions, complexes and coordination compounds, nomenclature, geometry of molecules, Polarity, Existing types of forces between ionic and polar compounds, hydrogen bonding, Lewis structures.
4	CHEMICAL REACTION: Classification of chemical reactions, chemical Read, balance equations, number of oxidation and redox reactions, homogeneous and heterogeneous reactions, ionic equations, weighting term, excess reagents and limiting.
4	STATES OF MATTER: Kinetic and Potential Energy, State Solid, Liquid State, Gaseous State, Plasma, status changes.
4	SOLUTIONS: Types, modes of expressing the concentration and stoichiometry of solutions, Solubility, Aqueous Solutions, Vapor Pressure, Property 'Colligative, osmosis, dialysis, Sol, Gels and Colloids.
2	THERMODYNAMICS AND KINETIC: Thermodynamic and Read thermodynamic properties of chemical interest, speed 'reaction, chemical equilibrium, catalysis, equilibrium, Le Chatelier's Principle.
4	ACID BASES AND SALTS: acid-base theories, acids and bases and their properties, Strength of acid-base equilibria, pH and pOH, salts and their hydrolysis, titration, swabs and biological buffers.
1	NUCLEAR REACTIONS: Introduction, Main types of radiation, half-time, fission and fusion, Radioactive Isotopes - Medical Applications - field radiation safety.
4	ALKANES: Carbon Hybridization; Alkanes, formulas, nomenclature, structures, conformations, isomers and stereoisomers, Cycloalkanes, sources and reactions, combustion and halogenation of alkanes, alkyl halides; Activities 'optical, Racemi, compounds with more' chiral centers, racemes Resolution expiry stereochemical in the formation of chiral centers.

4	HYDROCARBONS UNSATURATED: Property, Alkenes and Nomenclature, Alkynes and Nomenclature, geometric isomers, Reactions of Alkenes and Alkynes, conjugated dienes, allyl systems, Electrophilic addition to alkenes and alkynes, catalytic hydrogenation, polymerization, Aromatic Hydrocarbons and reactions.
2	Alkyl halides: Nucleophilic Substitution and Elimination reactions, Grignard reagents.
4	AROMATIC COMPOUNDS: aroma 'and Eteroaromaticita, Benzene and derivatives, electrophilic aromatic substitution, electronic effects of the substituents, phenols and quinones, aryl halides, amines: structure and reactivity, heterocyclic compounds: pyrrole, Imidazole, pyridine, Pyrimidine, Purine, tautomerism structures heterocyclic.
1	ALCOHOL: alcohols, diols, glycerol, synthetic routes and reactions.
3	CARBONYL COMPOUNDS: aldehydes and ketones, nucleophilic Addition, hemiacetals, acetals, cyanohydrin, Imines, Enamines. Oxidation and reduction, acidity 'of the hydrogens in keto-enol tautomerism, carbanions, aldol condensations.
3	CARBOXYLIC ACIDS AND DERIVATIVES: carboxylic acids and their derivatives, nucleophilic substitution acyl chlorides of acids, amines and Starches, anhydrides, esters, Thioesters, Claisen condensation, esterification and hydrolysis of esters, oxo, keto acids, dicarboxylic acids, esters and anhydrides biological importance
4	Carbohydrates: monosaccharides, steric Series, cyclic structures, Mutarotation, glycoside bond, glycosides, oxidation, reduction, Reducing sugars, ribose, Deoxyribose, glucose, galactose, mannose, fructose, disaccharides (maltose, cellobiose, lactose, sucrose), polysaccharides (Amilosis , Amylopectin, cellulose, glycogen), amino sugars.
3	Lipids: Saturated and unsaturated fatty acids omega 3 and omega 6, simple and complex lipids, terpenes and steroids, phospholipids, biological role of lipids, detergents and soaps, lipids related to food
2	Proteins: Amino acids: structure and configuration, acid-base equilibria of amino acids and peptides, isoelectric point and isoionico, Bond peptide - peptide structures, synthesis of polypeptides, enzymes.
2	Nucleic Acids: purine and pyrimidine bases - Structural aspects of Nucleosides and Nucleotides, polymers of nucleic acids.
2	VITAMINS: Chemical structure and function
1	ANALYSIS: Characteristics of a metabolic cycle and energy balance.
1	ANALYSIS: clinical and management biochemical aspects of laboratory medicine.

**MODULE**  
**CHEMISTRY AND INTRODUCTORY BIOCHEMISTRY**

*Prof.ssa FRANCESCA DI GAUDIO - Sede HYPATIA, - Sede HYPATIA*

**SUGGESTED BIBLIOGRAPHY**

CHIMICA E PROPEDEUTICA BIOCHIMICA con inclusi il kit di modellistica molecolare.

F. A. Bettelheim, W. H. Brown, M. K. Campbell, S. Farrell

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G. ALONSO ESERCIZI DI CHIMICA EDIERMES non piu' in stampa

<b>AMBIT</b>	50423-Struttura, funzione e metabolismo delle molecole d'interesse biologico
<b>INDIVIDUAL STUDY (Hrs)</b>	90
<b>COURSE ACTIVITY (Hrs)</b>	60

**EDUCATIONAL OBJECTIVES OF THE MODULE**

Knowing the atomic and molecular basis of matter

Knowing the atomic and molecular basis of life processes

Know the characteristics of the elements and molecules present in biological systems and the underlying principles of their behavior in order to understand human metabolic processes

**SYLLABUS**

Hrs	Frontal teaching
2	CALCULATIONS AND MEASURES: Introduction, Scientific Method, Matter, Measurement Systems, Main units' measurement, Accuracy, Accuracy, Errors, significant expressions and notations Scientific, Significant Figures in Calculations.
4	ATOMS, MOLECULES AND ATOMIC MODELS: Introduction, Atomic Structure, Electronic Configurations, and energy levels Sublayers, octet rule, Electronic filling, Periodic Table, Orbital and MO theory, properties' periodical.
4	CHEMICAL BOND AND FORCES INTERMOLECULAR: the theory of the chemical bond, Covalent compounds, ionic compounds, polyatomic ions, complexes and coordination compounds, nomenclature, geometry of molecules, Polarity, Existing types of forces between ionic and polar compounds, hydrogen bonding, Lewis structures.
4	CHEMICAL REACTION: Classification of chemical reactions, chemical Read, balance equations, number of oxidation and redox reactions, homogeneous and heterogeneous reactions, ionic equations, weighting term, excess reagents and limiting.
4	STATES OF MATTER: Kinetic and Potential Energy, State Solid, Liquid State, Gaseous State, Plasma, status changes.
4	SOLUTIONS: Types, modes of expressing the concentration and stoichiometry of solutions, Solubility, Aqueous Solutions, Vapor Pressure, Property 'Colligative, osmosis, dialysis, Sol, Gels and Colloids.
2	THERMODYNAMICS AND KINETIC: Thermodynamic and Read thermodynamic properties of chemical interest, speed 'reaction, chemical equilibrium, catalysis, equilibrium, Le Chatelier's Principle.
4	ACID BASES AND SALTS: acid-base theories, acids and bases and their properties, Strength of acid-base equilibria, pH and pOH, salts and their hydrolysis, titration, swabs and biological buffers.
1	NUCLEAR REACTIONS: Introduction, Main types of radiation, half-time, fission and fusion, Radioactive Isotopes - Medical Applications - field radiation safety.
4	ALKANES: Carbon Hybridization; Alkanes, formulas, nomenclature, structures, conformations, isomers and stereoisomers, Cycloalkanes, sources and reactions, combustion and halogenation of alkanes, alkyl halides; Activities 'optical, Racemi, compounds with more' chiral centers, racemes Resolution expiry stereochemical in the formation of chiral centers.



4	HYDROCARBONS UNSATURATED: Property, Alkenes and Nomenclature, Alkynes and Nomenclature, geometric isomers, Reactions of Alkenes and Alkynes, conjugated dienes, allyl systems, Electrophilic addition to alkenes and alkynes, catalytic hydrogenation, polymerization, Aromatic Hydrocarbons and reactions.
2	Alkyl halides: Nucleophilic Substitution and Elimination reactions, Grignard reagents.
4	AROMATIC COMPOUNDS: aroma 'and Eteroaromaticita, Benzene and derivatives, electrophilic aromatic substitution, electronic effects of the substituents, phenols and quinones, aryl halides, amines: structure and reactivity, heterocyclic compounds: pyrrole, Imidazole, pyridine, Pyrimidine, Purine, tautomerism structures heterocyclic.
1	ALCOHOL: alcohols, diols, glycerol, synthetic routes and reactions.
3	CARBONYL COMPOUNDS: aldehydes and ketones, nucleophilic Addition, hemiacetals, acetals, cyanohydrin, Imines, Enamines. Oxidation and reduction, acidity 'of the hydrogens in keto-enol tautomerism, carbanions, aldol condensations.
3	CARBOXYLIC ACIDS AND DERIVATIVES: carboxylic acids and their derivatives, nucleophilic substitution acyl chlorides of acids, amines and Starches, anhydrides, esters, Thioesters, Claisen condensation, esterification and hydrolysis of esters, oxo, keto acids, dicarboxylic acids, esters and anhydrides biological importance
4	Carbohydrates: monosaccharides, steric Series, cyclic structures, Mutarotation, glycoside bond, glycosides, oxidation, reduction, Reducing sugars, ribose, Deoxyribose, glucose, galactose, mannose, fructose, disaccharides (maltose, cellobiose, lactose, sucrose), polysaccharides (Amilosis , Amylopectin, cellulose, glycogen), amino sugars.
3	Lipids: Saturated and unsaturated fatty acids omega 3 and omega 6, simple and complex lipids, terpenes and steroids, phospholipids, biological role of lipids, detergents and soaps, lipids related to food
2	Proteins: Amino acids: structure and configuration, acid-base equilibria of amino acids and peptides, isoelectric point and isoionico, Bond peptide - peptide structures, synthesis of polypeptides, enzymes.
2	Nucleic Acids: purine and pyrimidine bases - Structural aspects of Nucleosides and Nucleotides, polymers of nucleic acids.
2	VITAMINS: Chemical structure and function
1	ANALYSIS: Characteristics of a metabolic cycle and energy balance.
1	ANALYSIS: clinical and management biochemical aspects of laboratory medicine.

## MODULE BIOCHEMISTRY I

*Prof.ssa ITALIA DI LIEGRO - Sede HYPATIA, - Sede HYPATIA*

### SUGGESTED BIBLIOGRAPHY

1. Baynes JW., Dominiczack MH. Biochimica per le discipline biomediche, CEA Ambrosiana
  2. Devlin T.M. Biochimica con aspetti clinici, Ed. Idelson-Gnocchi
  3. Lieberman M, Marks A.D. Biochimica Medica, seconda edizione, Casa Editrice Ambrosiana
  4. Siliprandi N., Tettamanti G. Biochimica Medica, Ed. Piccin
- Inoltre, di consultazione, per l'approfondimento di aspetti specifici:
1. Berg J.M., Tymoczko J.L., Stryer L. Biochimica, 5a ed. italiana 2003, Zanichelli
  2. Nelson D.L., Cox M.M. I Principi di Biochimica di Lehninger, Zanichelli
  3. Garrett R.H., Grisham C.M. Biochimica, Ed. Zanichelli
- Nel corso delle lezioni verranno anche fornite fonti bibliografiche specifiche per approfondimenti non presenti nei libri di testo. In addition, a few updated scientific reviews could be suggested on specific topics not covered in the textbook and/or of special interest to the achievement of the educational goals.

<b>AMBIT</b>	50423-Struttura, funzione e metabolismo delle molecole d'interesse biologico
<b>INDIVIDUAL STUDY (Hrs)</b>	90
<b>COURSE ACTIVITY (Hrs)</b>	60

### EDUCATIONAL OBJECTIVES OF THE MODULE

Knowing the biochemical and molecular bases of cellular activities and understanding of the mechanisms that regulate metabolic processes. In particular, the student has to know the biological molecules and the main metabolic processes in which they are involved; knowing and understanding the mode of action of enzymes, the fundamentals of their regulation and catalytic mechanisms, the bases of bioenergetics. The student must already know how to apply his/her knowledge to interpret the behavior of molecules in biological processes and have the ability to understand the molecular mechanisms underlying metabolic processes of life. Finally, he/she should already have to know the molecular mechanisms of action of chemical messengers and the main modes of extracellular signal transduction.

## SYLLABUS

Hrs	Frontal teaching
3	Structure and composition of biological membranes. Fluid mosaic model of the cell membrane and model of the mosaic of domains. Membrane transport. Osmosis. Simple and facilitated diffusion. Glucose transporters (GLUTs). Primary and secondary active transport. Sodium-glucose symporter. Sodium/potassium -dependent ATPase. Calcium-dependent ATPase. Other calcium ion transport systems. Cardiotonic glycosides.
5	Signal transduction mechanisms. Adenylate cyclase system. Tetanus toxin and cholera toxin. Botulism. Pertussis toxin and diphtheria toxin . Phosphoinositide system. Calcium/calmodulin – dependent systems . Cyclic GMP ( cGMP ). Guanylyl cyclase: cytosolic and trans-membrane isoforms. Nitric oxide synthase (NOS). Process of vision. Vitamin A. Transducin.
4	Oxygen-binding chromoproteins. Myoglobin (Mb). Hemoglobin (Hb). Oxygen transport. Direct and indirect carbon dioxide transport . Hb buffering action. Metabolism of Hb. Methemoglobin . Carboxyhemoglobin . Carbaminohemoglobin . Glycated hemoglobin. Abnormal hemoglobins . Hemoglobinopathies.
8	Enzymes : General concepts. Mechanism of enzymatic catalysis. The active site. Enzyme specificity. Isoenzymes. Constitutive and inducible enzymes . Enzyme kinetics : influence of substrate concentration on enzyme activity; influence of enzyme concentration; influence of temperature and pH. Michaelis-Menten constant. Sequential and Ping Pong Reactions. Cooperative systems. Allosteric regulation: Monod-Wyman-Changeux concerted or symmetry model. Koshland model of allosterism. Mechanisms of enzymatic inhibition. Use of enzymatic inhibitors in medicine. ACE –inhibitors. Antifolates. Aspirin. Regulation of enzyme activity : allosteric regulation. Covalent modifications of enzymes: phosphorylation , dephosphorylation , ADP-ribosylation. Conversion of zymogens into active enzymes. Plasmatic enzymes in medicine. Vitamins . Properties and functions of fat-soluble and water-soluble vitamins. Vitamins B1 , B6 and B12 . Folic acids and mono carbon unit transfer.
14	Metabolism of carbohydrates: digestion of polysaccharides and disaccharides; absorption of monosaccharides. Glucose uptake into cells and glucose phosphorylation. Hexokinase and glucokinase . Glycogen metabolism : glycogen synthesis and glycogen lysis. Glycemic control. Glycolysis in the presence and absence of oxygen. Gluconeogenesis. Cori cycle. Reducing equivalent transfer from the cytoplasm to the mitochondria via shuttle systems: glycerol-3-phosphate shuttle; malate-aspartate shuttle. Oxidation of pyruvate. Krebs cycle. Pentose phosphate shunt. Glucuronic acid metabolism. Metabolism of fructose. Galactose metabolism. Glycosaminoglycans and proteoglycans. Metabolism of ethanol and its effects on glucose metabolism.
11	Metabolism of lipids. Lipoprotein: general concepts . Chylomicrons. VLDL and their metabolism. LDL receptors . Atherosclerosis . Scavenger receptor. Metabolic utilization of fatty acids. Albumin. Transport of acyl groups across the inner membrane of the mitochondria: role of carnitine. Beta-oxidation of fatty acids. Metabolism of ketone bodies. Ketosis and ketoacidosis. Biosynthesis of fatty acids. Metabolism of triglycerides. Phospholipid metabolism. Cholesterol metabolism. Bile acids. Vitamin D.

3	Oxidative phosphorylation (OXPHOS): the electron transport chain and ATP synthesis. Factors that interfere with oxidative phosphorylation. OXPHOS physiological uncoupling agents: UCPS . Mitochondrial toxins.
8	Metabolism of amino acids. Essential and not-essential amino acids. Amino acid catabolism. Transamination. Oxidative deamination. Transdeamination concept. Decarboxylation. Ammonia metabolism. Metabolism of glutamate. GABA. Synthesis and catabolism of glutamine. Synthesis of carbamoyl phosphate. Urea cycle. Metabolism of methionine and homocysteine. Metabolism of tryptophan. Histidine metabolism. Metabolism of phenylalanine and tyrosine. Phenylketonuria (PKU), alkaptonuria, albinism. The polyamines. Creatine and phosphocreatine: biosynthesis and function.
4	Metabolism of nucleotides . Biosynthesis of purine and pyrimidine nucleotides. Biosynthesis of thymidylic acid. Synthesis by base recovering. Catabolism of purine nucleotides . Uric acid metabolism. Hyperuricaemia. Gout and Lesch-Nyhan syndrome. Ribonucleotide reductase and production of deoxyribonucleotides.

## MODULE BIOCHEMISTRY I

*Prof.ssa MARIANNA LAURICELLA - Sede IPPOCRATE, - Sede IPPOCRATE*

### SUGGESTED BIBLIOGRAPHY

1. Siliprandi N., Tettamanti G. Biochimica Medica, Ed. Piccin
2. Devlin T.M. Biochimica con aspetti clinici, Ed. Idelson-Gnocchi
3. Murray RK, et al. Harper Biochimica, Ed. McGraw-Hill
4. Berg J.M., Tymoczko J.L., Stryer L. Biochimica, 5a ed. italiana 2003, Zanichelli
5. Nelson D.L., Cox M.M. I Principi di Biochimica di Lehninger, Zanichelli
6. Garrett R.H., Grisham C.M. Biochimica, Ed. Zanichelli

<b>AMBIT</b>	50423-Struttura, funzione e metabolismo delle molecole d'interesse biologico
<b>INDIVIDUAL STUDY (Hrs)</b>	90
<b>COURSE ACTIVITY (Hrs)</b>	60

### EDUCATIONAL OBJECTIVES OF THE MODULE

Knowing the biochemical and molecular bases of cellular activities and understanding of the mechanisms that regulate metabolic processes. In particular, the student has to know the biological molecules and the main metabolic processes in which they are involved; knowing and understanding the mode of action of enzymes, the fundamentals of their regulation and catalytic mechanisms, the bases of bioenergetics. The student must already know how to apply his/her knowledge to interpret the behavior of molecules in biological processes and have the ability to understand the molecular mechanisms underlying metabolic processes of life. Finally, he/she should already have to know the molecular mechanisms of action of chemical messengers and the main modes of extracellular signal transduction.

## SYLLABUS

Hrs	Frontal teaching
3	Membrane transport Simple and facilitated diffusion. Active transport. Glucose transporters (GLUT). Na <sup>+</sup> -glucose symport. Na <sup>+</sup> /K <sup>+</sup> -dependent ATPase. Ca <sup>++</sup> dependent ATPase. Other transport systems for calcium.
5	Signal transduction mechanisms Adenylate cyclase system. Cholera toxin. Pertussis and diphtheria toxins. Phosphoinositides system. Ca <sup>++</sup> -calmodulin system. Cyclic GMP (cGMP). Membrane and cytosolic guanylate cyclase. Nitric Oxide synthase (NOS). Vision process. Vitamin A. Transducin.
4	Oxygen ligand chromoproteins Myoglobin (Mb) and Haemoglobin (Hb). Oxygen transport. Carbonic anhydride transport. Haemoglobin buffer action. Meta-haemoglobin Carboxy-haemoglobin. Atypical haemoglobins. Haemoglobinopathy.
8	Enzymes Generality. Enzymatic catalysis mechanisms. Active site. Specificity. Iso-enzymes. Constitutive and inducible enzymes. Enzymatic kinetics: influence of substrate concentration, influence of enzyme concentration; Temperature and pH influence. Michaelis-Menten constant. Sequential and ping-pong reactions. Monod and Koshland cooperative systems. Enzymatic inhibition mechanisms. Enzyme inhibitors in medicine. Statins. Anti-folic. Aspirin. Enzymatic activity regulation: Allosteric regulation. Covalent modifications: phosphorylation, ADP-ribosylation PARP. Conversion of zymogen into active enzymes. Vitamin K. Anticoagulants.
14	Carbohydrates metabolism Glucose uptake in the cells. Glucose phosphorylation. Hexokinase and glucokinase. Glycogen Metabolism: Glycogen synthesis and Glycogenolysis Glycolysis in the presence or absence of oxygen. Gluconeogenesis. Cori cycle. Transfer of reducing equivalents from cytoplasm to mitochondria through shuttle systems: phosphoenolpyruvate/glycerol-3-phosphate system; malate/aspartate system. Pyruvate oxidation. Krebs cycle. Pentose-phosphate cycle. Glucuronic acid metabolism. Fructose metabolism. Galactose metabolism. Glycosaminoglycans
12	Lipid metabolism Lipoproteins: generalità. Chylomicrons destiny. VLDL destiny. LDL receptors. Atherosclerosis. Scavenger receptor. Metabolic utilization of fatty acids. Acyl transfer through inner mitochondrial membrane: carnitine function beta-oxidation of fatty acids. Ketone bodies metabolism Ketosis and Ketoacidosis. Fatty acid biosynthesis. Triglycerides metabolism. Phospholipids metabolism. Cholesterol metabolism.
8	Amino acids metabolism Essential and non essential amino acids. Amino acids catabolism Transamination. Oxidative deamination. Decarboxylation. Metabolic destiny of ammonia. Glutamate synthesis Glutamine synthesis and demolition. carbamylphosphate synthesis. Urea Cycle. Methionine metabolism. phenylalanine and tyrosine metabolism. Phenylketonuria. Polyamines. Creatin and phosphocreatin: synthesis and function
2	Oxidative phosphorylation Biologic redox chain. Q coenzyme, cytochromes, ATP synthase. Phosphorylation at the level of substrate.

2	Vitamins General considerations. Features and functions of liposoluble and hydrosoluble vitamins. B1, B6 e B12 vitamins. Folic Acids. Monocarbon unit metabolism.
2	Nucleotide metabolism Purine e pyrimidine nucleotides biosynthesis. timidilic acid biosynthesis. Recovery nucleotides biosynthesis. Purine nucleotide catabolism Alterations of uric acid metabolism. Hyperuricemia

## MODULE BIOCHEMISTRY I

*Prof.ssa SONIA EMANUELE - Sede CHIRONE, - Sede CHIRONE*

### SUGGESTED BIBLIOGRAPHY

1. Siliprandi N., Tettamanti G. Biochimica Medica, Ed. Piccin
2. Devlin T.M. Biochimica con aspetti clinici, Ed. Idelson-Gnocchi
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<b>AMBIT</b>	50423-Struttura, funzione e metabolismo delle molecole d'interesse biologico
<b>INDIVIDUAL STUDY (Hrs)</b>	90
<b>COURSE ACTIVITY (Hrs)</b>	60

### EDUCATIONAL OBJECTIVES OF THE MODULE

Detailed knowledge of molecules of biologic interest and principal metabolic processes in which they are involved. Knowledge and understanding of enzyme action modality, regulation and catalysis. Knowledge and understanding of bioenergetic basis.

## SYLLABUS

Hrs	Frontal teaching
3	Membrane transport Simple and facilitated diffusion. Active transport. Glucose transporters (GLUT). Na <sup>+</sup> -glucose symport. Na <sup>+</sup> /K <sup>+</sup> -dependent ATPase. Ca <sup>++</sup> dependent ATPase. Other transport systems for calcium.
5	Signal transduction mechanisms Adenylate cyclase system. Cholera toxin. Pertussis and diphtheria toxins. Phosphoinositides system. Ca <sup>++</sup> -calmodulin system. Cyclic GMP (cGMP). Membrane and cytosolic guanylate cyclase. Nitric Oxide synthase (NOS). Vision process. Vitamin A. Transducin.
4	Oxygen ligand chromoproteins Myoglobin (Mb) and Haemoglobin (Hb). Oxygen transport. Carbonic anhydride transport. Haemoglobin buffer action. Meta-haemoglobin Carboxy-haemoglobin. Atypical haemoglobins. Haemoglobinopathy.
8	Enzymes Generality. Enzymatic catalysis mechanisms. Active site. Specificity. Iso-enzymes. Constitutive and inducible enzymes. Enzymatic kinetics: influence of substrate concentration, influence of enzyme concentration; Temperature and pH influence. Michaelis-Menten constant. Sequential and ping-pong reactions. Monod and Koshland cooperative systems. Enzymatic inhibition mechanisms. Enzyme inhibitors in medicine. Statins. Anti-folic. Aspirin. Enzymatic activity regulation: Allosteric regulation. Covalent modifications: phosphorylation, ADP-ribosylation PARP. Conversion of zymogen into active enzymes. Vitamin K. Anticoagulants.
14	Carbohydrates metabolism Glucose uptake in the cells. Glucose phosphorylation. Hexokinase and glucokinase. Glycogen Metabolism: Glycogen synthesis and Glycogenolysis Glycolysis in the presence or absence of oxygen. Gluconeogenesis. Cori cycle. Transfer of reducing equivalents from cytoplasm to mitochondria through shuttle systems: phosphodioxyceton/glycerol-3-phosphate system; malate/aspartate system. Pyruvate oxidation. Krebs cycle. Pentose-phosphate cycle. Glucuronic acid metabolism. Fructose metabolism. Galactose metabolism. Glycosaminoglycans
12	Lipid metabolism Lipoproteins: generalità. Chylomicrons destiny. VLDL destiny. LDL receptors. Atherosclerosis. Scavenger receptor. Metabolic utilization of fatty acids. Acyl transfer through inner mitochondrial membrane: carnitine function. beta-oxidation of fatty acids. Ketone bodies metabolism. Ketosis and Ketoacidosis. Fatty acid biosynthesis. Triglycerides metabolism. Phospholipids metabolism. Cholesterol metabolism.
8	Amino acids metabolism Essential and non-essential amino acids. Amino acids catabolism. Transamination. Oxidative deamination. Decarboxylation. Metabolic destiny of ammonia. Glutamate synthesis. Glutamine synthesis and degradation. Carbamylphosphate synthesis. Urea Cycle. Methionine metabolism. Phenylalanine and tyrosine metabolism. Phenylketonuria. Polyamines. Creatin and phosphocreatin: synthesis and function.
2	Oxidative phosphorylation Biologic redox chain. Q coenzyme, cytochromes, ATP synthase. Phosphorylation at the level of substrate.
2	Vitamins General considerations. Features and functions of liposoluble and hydrosoluble vitamins. B1, B6 e B12 vitamins. Folic Acids. Monocarbon unit metabolism.

2

Nucleotide metabolism

Purine e pyrimidine nucleotides biosynthesis. thymidilic acid biosynthesis. Recovery nucleotides biosynthesis. Purine nucleotide catabolism Alterations of uric acid metabolism. Hyperuricemia.