COURSE OUTLINE
Interdepartmental Master Program "Medicinal Chemistry and Chemical Biology"
Departments of Chemistry (running Department) and Medicine
University of Patras

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Courses / Semester of Studies

First Semester		
A. Compulsory Course (1)		
Code	**ECTS**	**Title**
DDE 100	5	Discovery, Design and Evaluation of Drugs
B. Semi Optional Courses (5)		
	5	Semi Optional Course-I
	5	Semi Optional Course-II
	5	Semi Optional Course-III
	5	Semi Optional Course-IV
	5	Semi Optional Course-V
Total	**30**	
List of Semi Optional Courses		
BCC 110	5	Biomacromolecular and Combinatorial Chemistry
BTA 111	5	The Biomacromolecules as Targets for Therapeutic Approaches
GMD 112	5	Genetic and Molecular Basic of Diseases-Molecular Medicine
OCB 113	5	Organic Chemistry of Biological Processes
SCC 114	5	Structural and Combinatorial Medicinal Chemistry
OSD 115	5	Organic Synthesis of Drugs
ABM 116	5	Methods for Analysis of Bioactive Molecules
Second Semester		
A. Compulsory Courses and Diploma Thesis (3)		
Code	**ECTS**	**Title**
REM 201	5	Research Methodology
CHB 202	5	Chemical Biology
MDT 203	15	Master Diploma Thesis-I (Inception)
B. Semi Optional Course (1)		
	5	Semi Optional Course-VI
Total	**30**	
List of Semi Optional Courses		
BTI 217	5	Basic and Translational Immunology
PHA 218	5	Pharmacology (Mechanisms – Targets for Pharmacological Intervention)
Third Semester		
A. Compulsory Diploma Thesis		
MDT 304	30	Master Diploma Thesis-II (continuation, completion, writing and presentation)
Total	**30**	

COURSE OUTLINE "DISCOVERY, DESIGN AND EVALUATION OF DRUGS"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF COURSE	POSTGRADUATE (MSc)		
COURSE CODE	DDE 100	**SEMESTER OF STUDIES**	FIRST
COURSE TITLE	DISCOVERY, DESIGN AND EVALUATION OF DRUGS		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
Lectures	4	5

COURSE TYPE	General background (Compulsory)
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have knowledge of the basic principles of Organic Chemistry and Medicinal Chemistry.
TEACHING AND ASSESSMENT LANGUAGE:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes
By the end of this course the student will be able to: 1. Knows the procedure from the discovery of preliminary molecules, to the guide molecules, their optimization, the selection of drug candidates for clinical trials and the procedure to the approval of a prototype drug. 2. He/she is familiar with the general structure of a Research and Development department in the Pharmaceutical Industry as well as the turnovers carried out there. 3. Understands the pharmaceutical companies broader strategy for investing in drug discovery programs. 4. Is familiar with the categorization of drugs according to the type of molecules and route of administration and understands the difference between an active substance and a pharmaceutical drug. 5. Understands how a biological target is identified and selected and when it is considered druggable. 6. Understands the concepts of solubility, permeability, polarity, and lipophilicity. 7. Understands the concepts of pharmacodynamics and pharmacokinetics as well as how the physicochemical properties of a molecule affect the absorption, distribution, metabolism, excretion and toxicity and in general the bioavailability of a molecule. 8. He/she is familiar with the general biological tests applied for the evaluation of the activity and pharmacokinetic properties of lead molecules (assays). 9. Understands how to optimize activity, selectivity and pharmacokinetics of "guide"

molecules through Structure-Activity and Structure-Physicochemical Relationships Properties and the concept of pharmacoconsistent structure.

10. Knows basic causes of toxicity, importance of interaction of various drugs and safety indicators of a drug

11. Understands the factors considered when evaluating alternative formulations of a drug candidate from laboratory scale to kilogram scale.

12. Understands the importance of salt selection, crystal type and polymorphic solids in drug performance and their influence on active ingredient composition.

13. Understands the factors considered during the selection and optimization of the composition that will ultimately be used in production and how the specifications of the active substance are determined.

14. Is familiar with the activities related to the Development of Chemical Composition and Production Processes and the Principles of Good Manufacturing Practice (cGMP)

General Competences

By the end of this course the student will, furthermore, have developed the following skills (general abilities) related to the areas of the discovery, design and evaluation of drugs:

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to design and development of drugs.
2. Ability to apply this knowledge and understanding to the solution of problems related with the synthesis and evaluation of bioactive molecules.
3. Search, analysis and synthesis of data and information, using the necessary technologies
4. Generation of new research ideas
5. Development of critical thinking and decision making
6. Autonomous and Group work
7. Study skills needed for continued professional development.
8. Ability to work / interact with others on problems of a chemical or interdisciplinary nature in the interdisciplinary and international drug research and development environment.
9. Promotion of free, creative and inductive thinking

3. SYLLABUS

1. General about drugs

• The procedure from discovery to approval.

• General structure and turnover of the Research and Development (R&D) department of pharmaceutical companies.

• Active substance and pharmaceutical preparation.

• Drug classifications according to the type of molecules and the route of administration.

• Biological drug targets.

2. Introduction to Pharmacokinetics

• The route of a drug from administration to the target and the concepts of solubility, permeability, polarity, lipophilicity, hydrophilicity and acid-base behavior.

• Bioavailability, Absorption, Distribution, Metabolism, Excretion.

• Drug half-life- therapeutic dosage and therapeutic index.

3. Discovery - Target selection stage

• Types of target biomolecules.

• Traditional and modern approach to the selection of biological targets.

• Forward and reverse genetics and chemogenetics.

• Biological target certification criteria.

• Druggable targets.

4. Development of Biological Assays

• *In vitro* tests (binding, activity, selectivity, functionality).
• High Throughput Screening.
• *In vivo* tests, animal models.
• Assessment tests of pharmacokinetic properties

5. Drug design

• Molecule reservoirs for initial biological evaluation.
• Approach through diversity.
• Fragment Based Design.
• Design based on a natural substitute - Rational Design.
• Design based on existing drugs.
• Goal-based design - De novo design.
• Homology modeling - modeling of molecules - computational evaluation.

6. From qualifying molecules to guiding molecules

• Filters of inappropriate molecules.
• Druglikeness - Lipinski, Veber rules and other empirical guidelines.

7. Optimization of guide molecules and Selection of Drug Candidates

• Bonding interactions of functional groups
• Determination of Drug Carrier structure
• Structure-Activity Relationships (SARs) and Structure-Physicochemical Properties Relationships (SPRs)
• Toxicity and Drug Interactions

8. Drug Candidates and Development of Chemical Synthesis and Manufacturing Processes

• Criteria for selecting drug candidates
• Synthesis of active substance on a larger scale
• Selection of suitable salt, crystalline type / polymorph
• Determination of Critical Quality Parameters and Definition of specifications
• Optimization and Selection Criteria of Feasible and Sustainable Industrial Synthesis
• Chemical and Process Development
• Good Construction Practice

9. Case Studies of Drug Chemical Synthesis Development and Production Processes

• Omecamptiv Mecabril
• Ceralasertib

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of powerpoint presentation and molecular models in Teaching. The lectures of the course for each chapter, in the form of powerpoint, are posted on the internet from where students can retrieve them freely using a password given to them at the beginning of the course.
TEACHING METHODS	

Activity	***Semester workload*** **(contact hours)**
Lectures	24
Final examination	6
Student's study hours for learning activity	95
Course total	***125***

	(25 work load for each ECTS credit)	
STUDENT PERFORMANCE EVALUATION	1. Group (two students) work with related topics from the lectures. The grade contributes 40% to the final grade. 2. Oral examination after the end of the semester (60% of final grade). Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam. Minimum passing grade: 5/10. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades $\leq$ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and $\geq$ 9 = A 3. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course.	

5. RECOMMENDED BIBLIOGRAPHY

- *Suggested bibliography:*

Graham L. Patrick. "An Introduction to Medicinal Chemistry", Oxford University Press, 2017 ISBN 9780198749691 (available ebook).

- *Related academic sources and journals:*

Journal of Medicinal Chemistry, European Journal of Medicinal Chemistry, Bioorganic Chemistry, Bioorganic Chemistry and Medicinal Letters, Organic Process Research & Development

COURSE OUTLINE "BIOMACROMOLECULAR AND COMBINATORIAL CHEMISTRY"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRADUATE (MSc)		
COURSE CODE	BCC 110	**SEMESTER**	FIRST
COURSE TITLE	BIOMACROMOLECULAR AND COMBINATORIAL CHEMISTRY		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	5
COURSE TYPE	Special Background (Semi-optional course)		
PREREQUISITE COURSES:	There are not prerequisite courses. It is however recommended that students should at least have basic knowledge of Organic Chemistry and Biochemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is in English. Teaching and examinations may be performed in English in case foreign students participate in the postgraduate program		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	-		

2. LEARNING OUTCOMES

Learning outcomes
At the end of this course student should be able to: • Describe the most important methods for the protection and orthogonal deprotection of multifunctional compounds. • Know the most important solid supports used in solid phase organic synthesis. • Describe the most important methods for the attachment and detachment of various small molecules to solid supports. • Choose the most appropriate protecting group combination for a given synthesis. • Describe the most important methods for the protection/deprotection of amino acids. • Describe the most important solid supports used in solid phase peptide synthesis. • Describe the most important methods for the peptide chain elongation. • Recognize possible byproducts in a given synthesis. • Describe the most important methods for disulfide bond formation. • Choose the most appropriate materials and methods to create a small peptide or peptide library. • Know the basic principles and techniques of combinatorial chemistry. • Describe the most important methods for the selective protection and deprotection of nucleosides/nucleotides and monosaccharides. • Know the most important solid supports used in solid phase synthesis of ologonucleotides and oligosaccharides. • Describe the most important methods for the attachment of nucleotides/monosaccharides to and detachment of oligonucleotides/oligosaccharides from solid supports.

- Choose the most appropriate protecting group combination for a given synthesis of an ologonucleotide or ologosaccharide.
- Describe the most important methods for the oligonucleotide or oligosaccharide chain elongation.
- Recognize possible byproducts in a given synthesis of oligonucleotide/oligosaccharide.
- Describe the most important methods for assembling the chains of oligonucleotides and oligosaccharides (formation of phosphodiester bonds and glycosidic links).
- Choose the most appropriate materials and methods to create an oligosaccharide or oligonucleotide.

General Competences

By the end of this course the MSc student will, furthermore, have developed the following skills (abilities):

- Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related to the Organic Synthesis of biomolecules (peptides, proteins, oligonucleoties and oligosaccharides)
- Ability to apply this knowledge and understanding to solve problems related to the Organic Synthesis of biologically important macromolecules of non-familiar nature
- Ability to apply this knowledge for understanding other syntheses of other types of biomolecules
- Ability to adopt and apply methodology for solving non-familiar problems
- Study skill needed for continuous professional development
- Ability to interact with others in solving problems of chemical/biochemical nature

Generally, by the end of this course the MSc student will have developed the following general abilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment
- Production of new research ideas

3. SYLLABUS

1. Synthesis of peptides/proteins-Combinatorial Chemistry

Introduction

General principles of solid phase synthesis

Commonly used resins

Attachment methods

Basic reactions of organic synthesis on solid phase

Protecting groups in solid phase organic synthesis

Synthesis of peptides and proteins

General principles

Synthetic strategies

Step by step synthesis
Convergent synthesis
Resins for the synthesis of peptides
Methods for the protection and deprotection of amino acids
Methods for peptide chain elongation
Byproducts during synthesis
Chemoselective methods
Selected examples of synthesis
Combinatorial chemistry
Serial techniques for the preparation of libraries and sublibraries
Parallel techniques
Split-and-combine method
Encoded libraries
Selected examples of libraries preparation

2. Synthesis of oligonucleotides
The diester method
The triester method
The 1,3,2-dioxaphosphole method
The phosphite method
The solid-phase method
The combined chemical-enzymatic method

3. Synthesis of di- and oligosaccharides
Protecting groups - Monosaccharide derivatives for di- and oligonucleotide synthesis
Creating glycosidic links: the Koenigs-Knorr reaction *(*1,2-*trans)*; Halide catalysis *(*1,2-*cis)*; the glycosyl trichloroacetamidate (TCA) coupling (1,2-*cis* και 1,2-*trans*), the 1,2-anhydrosugar-thioglycoside coupling (1,2-*cis* and 1,2-*trans*), the n-pentenyl glycoside coupling (1,2-*cis* and 1,2-*trans*).
Solid phase oligonycleotide synthesis.

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of ICT (powerpoint) in teaching Use of ICT in the communication with the students
TEACHING METHODS	

Activity	***Semester workload***
Lectures	28
Final examination	3
Private study of the course material throughout the lecturing period. Preparation for the final examination.	94
Course total (25 work load for each ECTS credit)	***125***

STUDENT PERFORMANCE EVALUATION	1. Written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F.

	Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A 2. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course. 3. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam.

5. RECOMMENDED BIBLIOGRAPHY

- *Suggested bibliography:*

1. P. L.-Williams, F. Albericio and E. Giralt, Chemical Approaches to the Synthesis of Peptides and Proteins, CRC Press, New York, 1997.
2. G. Jung (Ed.), Combinatorial Peptide and Nonpeptide Libraries, A Handbook, VCH, 1996.
3. Novabiochem Catalog 2006/2007, Synthesis Notes.
4. Chan WC and White PD (Eds) Fmoc Solid Phase Peptide Synthesis - A Practical Approach, Oxford University Press, New York, 2000.
5. J. Jones, "Amino Acid and Peptide Synthesis", Oxford Chemistry Primers-Oxford Science Publications, Oxford University Press, Oxford, 1992.

- *Related academic sources and journals:*

1. Jürgen-Hinrich Fuhrhop and Guangtao Li, "*Organic Synthesis: Concepts and Methods*'', 3rd Ed. WILEY-VCH, Weinheim, 2003, pp. 309-356.

2. A. Miller and J. Tanner, "*Essentials of Chemical Biology: Structure and Dynamics of Biological Macromolecules"*, John Wiley & Sons, Ltd, Chichester, 2008, 93-119.

3. R. V. Stick, "Carbohydrates: The Sweet Molecules of Life'', Academic Press, San Diego, California, 2001.

COURSE OUTLINE "THE BIOMACROMOLECULES AS TARGETS FOR THERAPEUTIC APPROACHES"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRATUATE (MSc)		
COURSE CODE	BTA 111	**SEMESTER**	FIRST
COURSE TITLE	THE BIOMACROMOLECULES AS TARGETS FOR THERAPEUTIC APPROACHES		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	5
COURSE TYPE	Special Background (Semi Optional course)		
PREREQUISITE COURSES:	There are not prerequisite courses. It is, however, recommended that students should at least have basic knowledge of Organic Chemistry and Biochemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is however in English. Teaching may be performed in English in case of foreign students participate in the postgraduate program.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	-		

2. LEARNING OUTCOMES

Learning outcomes
At the end of this course the student will be able to: • Understand the effect of proteins / peptides and antibodies as drugs, as well as the action of drugs on proteins / peptides • Recognize different families and different structures of receptors • Understand signal transduction and its pharmacological control • Know the contribution of polysaccharides and glycoconjugates in pharmaceutics • Understand metabolic targeting • Know the contribution of enzymes to the pathogenesis of diseases and the use of specific enzymatic inhibitors as drugs • Know the importance of targeting nucleic acids to therapeutics
General Competences
By the end of this course the student will, furthermore, have developed the following skills (abilities): • Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related to The Biomacromolecules as Targets for Therapeutic Approaches • Ability to apply this knowledge and understanding to solve problems related to The Biomacromolecules as Targets for Therapeutic Approaches of non-familiar nature • Ability to apply this knowledge for understanding other biological processes

- Ability to adopt and apply methodology for solving non-familiar problems
- Study skill needed for continuous professional development
- Ability to interact with others in solving problems of chemical/biochemical or multidisciplinary nature

Generally, by the end of this course the student will have developed the following general abilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment

3. SYLLABUS

- Proteins and peptides (action of drugs on proteins / peptides, antibodies in pharmaceutical chemistry, proteins / peptides as drugs)
- Families and structures of cellular receptors, signal transduction and its pharmacological control, design of agonists and antagonists, specific signaling pathways as pharmacological targets
- Polysaccharides and glycoconjugates as drugs and metabolic targeting
- Enzymes [strategies for the targeting of enzyme activity, pharmaceutical uses of inhibitors (enzyme inhibitors of pathogenic organisms, insects, weeds, fungi and inhibitors of selected human enzymes), enzymes as drugs]
- Targeting nucleic acids to therapeutics (epigenetics, nucleic acid / nucleotide-related drugs)

4. TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY</td><td colspan="2">Face to face. Distance learning</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td colspan="2">Use of ICT (powerpoint) in teaching and in the communication with the student communication.</td></tr>
<tr><td>TEACHING METHODS</td><td colspan="2"><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>28</td></tr>
<tr><td>Final examination</td><td>3</td></tr>
<tr><td>Private study of the course material throughout the lecturing period.
Collaborative problem-solving work by the students working in teams of two, following the end of lecturing period.
Preparation for the final examination.</td><td>94</td></tr>
<tr><td>Course total
(25 work load for each ECTS credit)</td><td>125</td></tr>
</table></td></tr>
</table>

STUDENT PERFORMANCE EVALUATION	1. Following the end of the lecture period, oral examination of each student individually on the material of the given lectures by 4-member examination committee. The final grade is extracted from the individual grades of the 4 examiners. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades $\leq$ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades, the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and $\geq$ 9 = A 2. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course. 3. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam.

5. RECOMMENDED BIBLIOGRAPHY

1. G.M. Cooper, R.E. Hausman. The Cell: A Molecular Approach; Published by Sinauer Associates, Inc.
2. J.M. Berg, J.L. Tymoczko, L. Stryer. Biochemistry; W. H. Freeman and Company.

COURSE OUTLINE "GENETIC AND MOLECULAR BASIC OF DISEASES – MOLECULAR MEDICINE"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRATUATE (MSc)		
COURSE CODE	GMD112	**SEMESTER**	FIRST
COURSE TITLE	GENETIC AND MOLECULAR BASIC OF DISEASES – MOLECULAR MEDICINE		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	5

COURSE TYPE	Special Background (Semi-optional course)
PREREQUISITE COURSES:	There are not prerequisite courses. It is however recommended that students should at least have basic knowledge of Molecular Biology and Biochemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is in English. Teaching and examinations may be performed in English in case foreign students participate in the postgraduate program
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes
Στο τέλος αυτού του μαθήματος ο/η φοιτητής/τρια θα έχει κατανοήσει: • The underlying role of molecular mechanisms that differentiate disease from the normal state. • The importance of genetic analyzes in the population and in the diagnosis/prognosis of diseases • The importance of the genetic background in the prognosis of inherited genetic diseases • The combined action of genetic and epigenetic changes in the genome, as well as the effect of environmental factors on the manifestation and progression of diseases • The genotype-phenotype relationship in the manifestation of the genetic disease
General Competences
By the end of this course the MSc student will, furthermore, have developed the following skills (abilities): • Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related with the Molecular Medicine. • Ability to apply this knowledge and understanding to solve problems related to Molecular Medicine. • Study skill needed for continuous professional development. • Ability to understand the essential concepts, principles, and techniques related to the Molecular diagnosis of human diseases. • Ability to interact with colleagues from other scientific fields to solve interdisciplinary

problems.

Generally, by the end of this course the MSc student will have developed the following general abilities:

- The "holistic" picture of the pathophysiology of diseases, starting from the molecular level and ending with the visible manifestation of the disease
- The pharmaceutical possibilities to precisely target the cause of the disease

He has also acquired the elementary foundations of the following general abilities:

- Adapting to new situations
- Criticism and self-criticism
- Production of free, creative and inductive thinking

3. SYLLABUS

The course deals with the basic principles of human Genetics and specifically Molecular Genetics, focusing on understanding the causes that cause genetic and postgenetic diseases at the molecular level, and providing, at the same time, the basic tools for the application of Precision Medicine.

In particular, the following topics are included:

• Introduction to Molecular Medicine. Mutations. Types of mutations. Polymorphisms. Genetic markers. Monogenic diseases

• Allele heterogeneity. Genetic locus heterogeneity. Examples of monogenic diseases.

• Principles of clinical cytogenetics. Disorders in autosomal and race chromosomes

• Prenatal screening. Modern molecular diagnostic methods

• Mendelian inheritance. Autosomal and sex-linked inheritance

• Genetic diseases of the connective tissue

• Methods of determining monogenic diseases – Molecular Diagnosis.

• Epigenetic modifications and diseases in humans. Examples and determination methods.

• Multifactorial Physiological characteristics & multifactorial diseases. The genetics of multifactorial diseases

• Cancer. The Genetics of Cancer and Applications of Precision Medicine

4. TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY</td><td>Face to face. Distance learning</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of ICT (powerpoint), animation, video and screen projector. Use a simple table to solve exercises
Genetics problem solving methodology.
Exemplary solutions to Genetic and Molecular Biology exercises.</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>28</td></tr>
<tr><td>Final examination</td><td>3</td></tr>
<tr><td>Private study of the course material throughout the lecturing period.
Preparation for the final examination.</td><td>94</td></tr>
<tr><td>Course total
(25 work load for each ECTS credit)</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE</td><td>1. Written examination. Greek grading scale: 1 to 10.</td></tr>
</table>

EVALUATION	Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A 2. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course. 3. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam.

5. RECOMMENDED BIBLIOGRAPHY

- *Suggested bibliography:*

1. "Molecular Biology of Gene", James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine, Richard Losick, Pearson, 2014, ISBN 0321762436, 9780321762436.
2. "GENES VIII" B. Lewin, Benjamin Cummings 2003, ISBN 978-0131439818
3. "Genetics: From Gene to Genomes", Hartwell Leland, Hood Leroy, Goldberg Michael, Reynolds Ann, Silver Lee, McGraw-Hill Science/Engineering/Math, 2006, ISBN 978-0073227382.
4. "Genetics in Medicine - Thomson & Thomson", RL Nussbaum, RR Mclnnes, H.F. Willard, Elsevier, 2015, ISBN 978-1437706963
5. Related publications

COURSE OUTLINE "ORGANIC CHEMISTRY OF BIOLOGICAL PROCESSES"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRADUATE (MSc)		
COURSE CODE	OCB 113	**SEMESTER**	FIRST
COURSE TITLE	ORGANIC CHEMISTRY OF BIOLOGICAL PROCESSES		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	5
COURSE TYPE	Special Background (Semi Optional course)		
PREREQUISITE COURSES:	There are not prerequisite courses. It is, however, recommended that students should at least have basic knowledge of Organic Chemistry and Biochemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is however in English. Teaching may be performed in English in case of foreign students participate in the postgraduate program.		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	-		

2. LEARNING OUTCOMES

Learning outcomes
At the end of this course student should be able to: • Recognize the functional groups of organic compounds encountered in the biological systems and the factors which determine the acidity and the basicity and the electrophilicity and nucleophilicity, respectively, of the various molecules invlolved in the reactions occurring in the biological systems. • Describe with the aid of curly arrows the main mechanisms of the organic reactions of the biological systems and understand the differences within the same types of reactions in the way they are usually performed in the laboratory and the way taking place in Nature. • Comprehend the concepts of chirality and pro-chirality and their consequences on (a) the three-dimentional structure of organic compounds and (b) the stereochemical outcome of reactions involving chiral or prochiral molecules. • Recognize the main classes and the structural characteristics of biomolecules (lipids, carbohydrates, amino acids, peptides and proteins, nucleic acids, enzymes and coenzymes and comprehend the role of conjugated reactions and of high-energy compounds in biosynthesis. • Comprehend mechanistically the various steps involved in the biosynthesis of biologically avtive biomolecules/natural products, such as penicillins and cephalosporins as well as prostaglandins. • Comprehend and describe mechanistically the most important biological processes, such as hydrolyses, esterifications, thioesterifications, amidations, carbonyl condensations, carboxylations and decarboxylations, aminations and deaminations, single carbon transfers, rearrangements, isomerizations and epimerizations, oxidations and reductions of carbonyl

compounds, hydroxylations and other oxidations through metal complexes.

- Comprehend and describe basic concepts and the design of metabolism in living organisms
- Comprehend and describe the interconnection of major metabolic pathways, including photosynthesis (light and dark reactions), glycolysis/gluconeogenesis/citric acid cycle, fatty acid metabolism, amino acid biosynthesis and protein turnover, taking place in living organisms that result in extraction of energy from their environment to perform their functions and synthesize the building blocks of biomolecules.
- Comprehend the basic principles of metabolic control in biological systems.
- Comprehend the recurring motifs in metabolic regulation.
- Comprehend and describe common metabolic diseases (i.e. diabetes mellitus).

General Competences

By the end of this course the student will, furthermore, have developed the following skills (abilities):

- Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related to the Organic Chemistry of the biological processes
- Ability to apply this knowledge and understanding to solve problems related to the Organic Chemistry of the biological processes of non-familiar nature
- Ability to apply this knowledge for understanding other biological processes
- Ability to adopt and apply methodology for solving non-familiar problems
- Study skill needed for continuous professional development
- Ability to interact with others in solving problems of chemical/biochemical or multidisciplinary nature

Generally, by the end of this course the student will have developed the following general abilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment

3. SYLLABUS

- *Common Mechanisms in Biological Pathways* (functional groups, acids and bases – electrophiles and nucleophiles, mechanisms of electrophilic addition reactions, nucleophilic substitution reactions, nucleophilic carbonyl addition reactions, nucleophilic acyl substitution reactions, carbonyl condensation reactions, elimination reactions, oxidations and reductions)
- *Biomolecules* (chirality and pro-chirality, lipids, carbohydrates, amino acids, peptides and proteins, nucleic acids, enzymes, coenzymes, coupled reactions and high-energy compounds)
- *Biological Pathways with emphasis to Metabolism* [Basic concepts and design of metabolism in living organisms; interconnection of major metabolic pathways, including photosynthesis (light and dark reactions), glycolysis/gluconeogenesis/citric acid cycle, fatty acid metabolism, amino acid biosynthesis and protein turnover, taking place in living organisms; basic principles of metabolic control in biological systems; recurring motifs in metabolic regulation; common metabolic diseases]

- *Biosynthesis of selected Natural Products* (penicillins and cephalosporins, prostaglandins and other eicosanoids)
- *Summary of Biological Transformations* (hydrolyses, esterifications, thioesterifications and amidations, carbonyl condensations, carboxylations and decarboxylations, aminations and deaminations, 1-carbon transfers, rearrangements, isomerizations and epimerizations, oxidations and reductions of carbonyl compounds, hydroxylations and other oxidations via metal complexes)

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of ICT (powerpoint) in teaching and in the communication with the students.
TEACHING METHODS	See table below
STUDENT PERFORMANCE EVALUATION	1. Following the end of the lecture period, a collaborative problem-solving work is assigned to each pair of students. This work includes three problems based on the taught material. This work is returned to the instructors before the final examination and is marked. This mark forms the 40% of the final mark. 2. Oral examination on the material of the work of each student individually (60% of the final mark). Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades, the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A 3. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course.

Activity	***Semester workload***
Lectures	28
Final examination	3
Private study of the course material throughout the lecturing period. Collaborative problem-solving work by the students working in teams of two. Preparation for the final examination.	94
Course total ***(25 work load for each ECTS credit)***	**125**

5. RECOMMENDED BIBLIOGRAPHY

1. "The Organic Chemistry of Biological Pathways", J. McMurry, T. Begley, Robert and Company Publishers, Englewood, 2005.
2. "The Cell: A Molecular Approach", G.M. Cooper, R.E. Hausman, Sinauer Associates is an

imprint of Oxford University, 2015, ISBN 978-1605355405
3. “Biochemistry”, J.M. Berg, J.L. Tymoczko, L. Stryer, Palgrave MacMillan, 2011, ISBN 978-1429276351

COURSE OUTLINE FOR "STRUCTURAL AND COMPUTATIONAL MEDICINAL CHEMISTRY"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF COURSE	POSTGRADUATE (MSc)		
COURSE CODE	SCC 114	**SEMESTER OF STUDIES**	FIRST
COURSE TITLE	STRUCTURAL AND COMPUTATIONAL MEDICINAL CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
Lectures	4	5

COURSE TYPE	Field of Science (Advanced Spectroscopy methods and Molecular Modeling) (Semi Optional)
PREREQUISITE COURSES:	Typically, there are not prerequisite courses. The students should have knowledge of the basic principles of Organic Chemistry and NMR spectroscopy.
TEACHING AND ASSESSMENT LANGUAGE:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes
By the end of this course the student will be able to: • Interpret 1D and 2D 1H NMR spectra and explain their importance in the identification of the structure and conformation of biologically active molecules and analyze 1H NMR spectra of peptides /small proteins. • Interpret NMR spectra of other biologically important nucleus (13C, 19F and 31P NMR) and explain their importance in the identification of the structure and conformation of biologically active molecules. • Describe the basic concepts of Supramolecular Chemistry and explain the Principles of Molecular Recognition and analyze the type of interactions taking place during the formation of Supramolecular entities. • Explore the conformational space of bioactive molecules in solution and in combination with their receptors. • Design rationally novel and potent bioactive molecules with improved pharmacological properties. • Apprehend the three-dimensional crystalline and molecular structure of various materials: chemical/pharmaceutical molecules and biomolecules (proteins, DNA, RNA, complexes, viruses). • Use databases for extracting structural information as well as bioinformatics programs.
General Competences

By the end of this course the student will, furthermore, have developed the following skills (general abilities) related to the areas of NMR Spectroscopy, Supramolecular Chemistry, Computational Medicinal Chemistry and X- ray analysis:

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to the above areas.
2. Ability to apply this knowledge and understanding to the solution of problems related to the above areas.
3. Ability to adopt and apply methodology to the solution of non-familiar problems.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities:

- Searching, analysis and synthesis of facts and information, as well as using the necessary technologies
- Adaptation to new situations
- Decision making
- Autonomous (Independent) work
- Group work
- Exercise of criticism and self-criticism
- Promotion of free, creative and inductive thinking
- Work design and management

6. SYLLABUS

NMR

Basic information in the spectra of Nuclear Magnetic Resonance (NMR). Multiple-pulse sequences and their utility. 2D NMR spectra (J-Resolved, COSY, TOCSY, HSQC, HMQC, HMBC, NOESY, ROESY). Applications of 2D-NMR spectroscopy in the conformational analysis of aminoacids, proteins and other biaoactive molecules.

Active nulceus in NMR and their characteristic properties (abundance, gyromagnetic ratio, nucleus spin). NMR ^{13}C, ^{19}F και ^{31}P: Fully and partially decoupled spectra, chemical shifts, and coupling constants. Heteronuclear NMR and integration. Examples of NMR spectra in compounds of biological interest: a) ^{13}C NMR, ^{19}F NMR and ^{31}P NMR, b) ^{1}H NMR and ^{13}C NMR in compounds containing fluorine or/and phosphorus atoms.

Supramolecular Chemistry

Introduction to Supramolecular Chemistry.

Molecular Recognition. Types of Intramolecular interactions and Structural Complementarity. Factors affecting the structure and conformation of the Host-Guest Supramolecule. Examples of the most common Molecular Receptors and their structures.

Application of Supramolecular Chemistry (Biomimetic Systems, Self-Assembly Systems).

Computational Medicinal Chemistry (Design of Bioactive Molecules)

i) Molecular graphics, ii) Conformations of peptides and proteins. Molecular surfaces, iii) Potential energy surfaces, iv) Basic principle of Molecular Mechanics, v) Energy minimization methods. Examples and Applications.

Explore of conformational space of bioactive molecules: i) Monte Carlo method, ii) Grid-Scan method, iii) Molecular Dynamics method. Examples and Applications.

Principles of rational design of bioactive molecules based on receptor-substrate complex: i) Development of receptor homology model, ii) Explore of receptor active site, iii) Determination of pharmacophore groups, iv) Docking studies v) Optimization of a bioactive structure. Examples

and Applications.
Rational design of peptidomimetics molecules: i) Basic principles for depeptidize, ii) Examples and Applications.

X-ray Structure Analysis

- Determination of the three-dimensional structure of crystalline compounds by X-ray diffraction - The electron density function ρ(x, y, z).
- Structure of chemical/pharmaceutical molecules. Structural and functional characteristics of biomolecules (proteins, DNA, RNA, complexes, viruses).
- Qualitative-quantitative analysis by X-ray diffraction of polycrystalline materials.
- Utilizing databases to extract structural information. Principles of bioinformatics.
- Principles, instruments, applications, results.

7. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of powerpoint presentation in teaching.
TEACHING METHODS	

Activity	***Semester workload* (contact hours)**
Lectures	28
Final examination	3
Student's study hours for learning activity	94
Course total (25 work load for each ECTS credit)	***125***

STUDENT PERFORMANCE EVALUATION	1. Written examination after the end of the semester. Minimum passing grade: 5/10. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A 2. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course. 3. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam.

3. RECOMMENDED BIBLIOGRAPHY

- Suggested bibliography:

NMR

1. T. Mayromoustakos, I. Matsoukas, "NMR: Principles and applications of Nuclear Magnetic Resonance in Medicine, Medicinal Chemistry, Biochemistry, Food Chemistry", 1st Edition, G.B. Parisiannos, 2006. (In Greek language only).

2. H. Friebolin, “Basic One- and Two-Dimensional NMR Spectroscopy”, 3rd Revised Edition, Wiley-VCH, 1998.
3. Notes of lecturers in Greek.

Supramolecular Chemistry

1. J.-M. Lehn, “Supramolecular chemistry: concepts and perspectives”, 1st Edition, VCH, 1995.
2. Notes of lecturers in Greek.

Computational Medicinal Chemistry (Design of Bioactive Molecules)

1. T. Mavromoustakos, P. Zoumpoulakis, “Molecular Modelling: Applications in Organic and Pharmaceutical Chemistry”, 1st Edition, G.B. Parisiannos, 2008. (In Greek language only).
2. R.M. Silverstein, F.X. Webster, D.J. Kiemle, “Spectrometric Identification of Organic Compounds”, 7th Edition, John Wiley & Sons, 2005.
3. A.R. Leach, “Molecular Modelling: Principles and Applications», 2nd Edition, Prentice Hall, 2001.
4. Notes of lecturers.

X-ray Structure Analysis

1. J.P. Glusker, M. Lewis, M. Rossi, “Crystal Structure Analysis for Chemists and Biologists“, 1st Edition, VCH Publishers, Inc., New York, 1994.
2. G.A. Petsko, D. Ringe, “Protein Structure and Function“, 1st Edition, New Science Press, 2004.
3. S.M. Allen, E.L. Thomas, “The Structure of Materials“, 1st Edition, John Wiley & Sons, 1998.

Notes of lecturers in Greek.

- *Related academic sources and journals:*

All scientific articles used in teaching are available.

COURSE OUTLINE "ORGANIC SYNTHESIS OF DRUGS"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRATUATE (MSc)		
COURSE CODE	OSD 115	**SEMESTER**	FIRST
COURSE TITLE	ORGANIC SYNTHESIS OF DRUGS		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	5
COURSE TYPE	Special Background (Semi-optional course)		
PREREQUISITE COURSES:	There are not prerequisite courses. It is however recommended that students should at least have basic knowledge of Organic Chemistry and in particular Synthetic Organic Chemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is, however, in English. Teaching and examinations may be performed in English in case foreign students participate in the postgraduate program		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	-		

2. LEARNING OUTCOMES

Learning outcomes
At the end of this course student should be able to: • Understand the concept of chirality and its importance in the design and synthesis of drugs • Understand the approaches and the analytical techniques for the determination of enantiomeric and diastereomeric excess (ee/de) • Recognize chiral structural elements of chiral molecules and correlate them to potential chiral sustainable starting materials (amino acids, terpenes, sugars and other natural products • Know the most useful chiral reagents and catalysts which are suitable for basic transformations both in laboratory and industrial scale • Understand the mechanisms of the above and how the stereochemistry of the products is controlled in the transition state • Understand the advantages and the disadvantages of the various strategies of asymmetric synthesis: pools of chiral molecules-starting materials, chiral substrates, chiral reagents, asymmetric catalysis with metal ions/chiral ligands and organocatalysts • Suggest, depending on the case, the synthesis of chiral pharmaceutical molecules through resolution of racemetates, desymmetrization or application of the appropriate strategy of asymmetric synthesis • Recognize cycloaddition reactions and/or metal-mediated reactions in given synthetic schemes • Foresee the product(s) of a given cycloaddition reaction or a reaction mediated by metals

when the reactants are provided

- Choose appropriate reactants for the synthesis of a given target-molecule using the most appropriate cycloaddition reaction or metal-mediated reaction
- Know the most important cycloaddition reactions or metal-mediated reactions and to incorporate them in non-familiar synthetic schemes
- Know the most important multicomponent reactions (MCR) and in particular those leading to important scaffolds of pharmaceutical interest
- Foresee the product of a given multicomponent reaction (MCR) when the reacting components are given
- Choose appropriate reactants for the synthesis of a given target-molecule using the most appropriate multicomponent reaction (MCR)
- Know the most important methods for activation of C-H bonds and their application to the formation of new C-C και C-heteroatom bonds
- Recognize reactions for the activation of C-H bonds in given synthetic schemes
- Incorporate reactions for the activation of C-H bonds in non-familiar synthetic schemes
- Recognize the reactions involved in multi-step syntheses of drugs and explain, through the knowledge of their mechanism, their stereochemical outcome
- Describe alternative synthetic pathways to drugs which allow their application in large scale in the Pharmaceutical Industry
- Understand the necessity of changing the synthetic course from industrial to industrial scale for the synthesis of drugs

General Competences

By the end of this course the student will, furthermore, have developed the following skills (abilities):

- Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related to the Organic Synthesis of Drugs
- Ability to apply this knowledge and understanding to solve problems related to the Organic Synthesis of drugs of non-familiar nature
- Ability to apply this knowledge for understanding syntheses of other types of molecules of biological interest
- Ability to adopt and apply methodology for solving non-familiar problems
- Study skill needed for continuous professional development
- Ability to interact with others in solving problems of synthetic nature

Generally, by the end of this course the student will have developed the following general abilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment
- Production of new research ideas

3. SYLLABUS

A. Asymmetric Synthesis [12 h]

- Importance of chirality in Nature and in the development of bioactive molecules
- Importance of asymmetric synthesis
- Chiral elements
- Diastereomers and meso-compounds
- Analytical techniques for the determination of the optical purity
- Strategy in asymmetric synthesis
- Classical and kinetic resolution of enantiomers
- Chiral substrates – starting materials (Chiral Pool)
- Chiral reagents
- Chiral auxiliary groups
- Catalytic asymmetric synthesis with chiral organometallic complexes
- Applications to asymmetric reactions of epoxidation, dihydroxylation, aminohydroxylation, hydrogenation of various functional groups, sulfoxidation,
- Catalytic asymmetric synthesis with simple and biphasic organocatalysts,
- Applications to asymmetric reactions of epoxidation, sulfoxidation, reduction of various functional groups, alkylation, conjugate addition, Diels Alder and other cycloadditions, heteroatom introduction (oxidations), Henry/ Aza-Henry/ Mannich/ and aldol reactions,
- Examples from the syntheses of swainsonine, fluoxetine, efavirenz, (-)-frontalin, (-)-podorhizon, Indinavir, esomeprazole, naproxen, sugars, unnatural α-amino acids, β-amino acids, pregabalin and γ-amino acids, duloxetine, propranolol, damascene,metolachlor,
- Factors affecting the choice of strategy in asymmetric synthesis of a chiral drug in industrial scale
- Case-study: Development of the industrial asymmetric synthesis of Aliskiren

B. Topics of contemporary advanced Organic Synthesis with applications to the Pharmaceutical Industry [6 h]

- Cycloaddition reactions in the synthesis of a variety of compounds
- Metal-mediated reactions
- Multicomponent reactions (MCR) in the synthesis of a variety of compounds
- Activation of C-H bonds for C-C and C-heteroatom bond formation

C. Selected case-studies of organic synthesis of approved drugs

Selection from the following [6 h]:

- Darunavir (2nd generation inhibitor of the HIV-1 protease – Treatment of HIV)
- Aliskiren (Renin inhibitor – Treatment of hypertension)
- Sitagliptin (Dipeptyl-peptidase-4 inhibitor – Antidiabetic drug)
- Montelucast (Leucotriene receptor antagonist – Treatment of asthma/allergy)
- Sorafenib (Kinase inhibitor – Treatment of primary kidney cancer)
- MK4965 (Non-nucleoside reverse transcriptase inhibitor - Treatment of HIV-1)
- Tamiflu (Neuraminidase inhibitor – Treatment of influenza)
- Alogliptin [Dipeptidyl-peptidae-4 selective inhibitor 4 (DPP4) – Treatment of diabetes type 2]
- Bazedoxifen [Selecrive regulator of estrogen receptors (SERMs) – Treatment of ostmenopausal osteoporosis]
- Bilastine [Histamine H1 receptor (HRH1) antagonist - Treatment of allergic

rhinoconjunctivitis and of urticaria]

- Zucapsaicin (Vanilloid receptor type 1 selective agonist – Treatment of muscle and joints pain)
- Dronedarone (Multiple channels blocker – Antiarrhythmic drug)
- Icotinib [Selective inhibitor of tyrosine kinase of epidermal growth factor (EGFR-TKI) -2nd or 3rd line drug for advanced or metastatic stage of non-small cell lung cancer (NSCLC)]

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of ICT (powerpoint) in teaching Use of ICT in the communication with the students
TEACHING METHODS	

Activity	***Semester workload***
Lectures (4 hours / week for 6 weeks)	24
Final examination	6
Private study of the course material throughout the lecturing period Preparation of the team work and for the final oral examination	95
Course total (25 hours total workload for each ECTS credit)	**125**

STUDENT PERFORMANCE EVALUATION	1. Team (groups of two students) work (40% of the final mark) 2. Individual oral examination (60% of the final mark). Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A 3. Teaching and examinations are delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English in case foreign students attend the course.

5. RECOMMENDED BIBLIOGRAPHY

1. D. S. Johnson and J. J. Li, The Art of Drug Synthesis, Wiley-Interscience, New Jersey, 2007.
2. Z. Chen, B. Wang, J. Zhang, W. Yu, Z. Liu, and Y. Zhang, 'Transition metal-catalyzed C-H bond functionalizations by the use of diverse directing groups'*, Organic Chemistry Frontiers,* 2015, *2(9)*, 1107-1295 and references cited therein.
3. N. Kuhl, M. N. Hopkinson, J. Wencel-Delord, and F. Glorius, 'Beyond directing groups: Transition-metal-catalyzed C-H activation of simple arenes'*, Angewandte Chemie International Edition*, 2012, *51*, 10236-10254 and references cited therein.
4. J. Yamaguchi, A. D. Yamaguchi, and K. Itami, 'C-H bond functionalization: Emerging synthetic tools for natural products and pharmaceuticals'*, Angewandte Chemie International Edition,* 2012,

51, 8960-9009 and references therein.
5. B. Wang, D. Qiu, Y. Zhang, and J. Wang, 'Recent advances in C(sp3)-H bond functionalization via metal-carbene insertions', *Beilstein Journal of Organic Chemistry,* 2016, *12,* 796-804 and references cited therein.
6. T. Gensch, M. N. Hopkinson, F. Glorius, and J. Wencel-Delord. 'Mild metal-catalyzed C-H activation: examples and concepts', *Chemical Society Reviews*, 2016, *45*, 2900-2936 and references cited therein.
7. P. Wyatt and S. Warren, *Organic Synthesis: Strategy and Control*, Wiley, Chichester, 2007.
8. T.-L. Ho, *Tandem Organic Reactions*, Wiley, New York, 1992.
9. L. F. Tietze and N. Rackelmann, 'Domino reactions in the synthesis of heterocyclic natural products and analogs', *Pure Appl. Chem.* 76 (2004) 1967- 1983.
10. K.C. Nikolaou and E.J. Sorensen, *Classics in Total Synthesis: Targets, Strategies, Methods*, VCH, Weinheim, 1996.
11. K.C. Nikolaou and S.A. Snyder, *Classics in Total Synthesis II: More Targets, Strategies*, Methods, Wiley-VCH, Weinheim, 2003.
12. J.-H. Fuhrhop and G. Li, *Organic Synthesis: Consepts and Methods*, Wiley-VCH, Weinheim, 2003.
13. A. Dömling, W. Wang, and K. Wang, 'Chemistry and Biology of Multicomponent Reactions', *Chemical Reviews*, 2012, *112*, 3083-3135 and references cited therein.
14. A. Dömling, W. Wang, and K. Wang, 'Recent Developments in Isocyanide Based Multicomponent Reactions in Applied Chemistry', *Chemical Reviews*, 2006, *106*, 17-89 and references cited therein.
15. Classics in Stereoselective synthesis, Eds. E. M. Carreira and L. Kvaerno, ISBN: 978-3-527-29966-9, Wiley 2009.
16. Asymmetric Organocatalysis, Ed. B. List, ISBN 978-3-642-02815-1, Springer 2009.
17. Asymmetric synthesis of drugs and natural products, Ed. A. Nag, ISBN: 9781315302317. Taylor & Francis 2018.

COURSE OUTLINE "METHODS FOR ANALYSIS OF BIOACTIVE MOLECULES"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRATUATE (MSc)		
COURSE CODE	ABM 116	**SEMESTER**	FIRST
COURSE TITLE	METHODS FOR ANALYSIS OF BIOACTIVE MOLECULES		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures		4	5
COURSE TYPE	Special Background (Semi-optional course)		
PREREQUISITE COURSES:	There are not prerequisite courses. It is however recommended that students should at least have basic knowledge of Analytical Chemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is, however, in English. Teaching and examinations may be performed in English in case foreign students participate in the postgraduate program		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	-		

2. LEARNING OUTCOMES

Learning outcomes
At the end of this course student should be able to: 1. Describe analytical techniques used in the analysis of biomolecules and their importance in their identification, study and quantitative analysis. 2. Choose the appropriate method for the study of unknown biological interested samples. 3. Select appropriate analytical methods for protein purity. 4. Combine information from various techniques to analyze complex samples.
General Competences
By the end of this course the student will, furthermore, have developed the following skills (abilities): • Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related with the analysis of bioactive molecules. • Ability to apply this knowledge and understanding to solve problems related with the analysis of drugs of non-familiar nature. • Ability to apply this knowledge for understanding analysis of other types of biological interested molecules. • Ability to adopt and apply methodology for solving non-familiar problems • Study skill needed for continuous professional development • Ability to interact with others in solving problems of analysis of bioactive molecules *Generally, by the end of this course the student will have developed the following general abilities:*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment
- Production of new research ideas

3. SYLLABUS

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC): Fundamentals and Organology. Theory and practice in HPLC. Retention mechanisms. Column and eluent selection. Optimization of methodology. Applications of the HPLC technique in analysis.

MASS SPECTROMETRY (MS): Ionization Methods. Mass analyzers. Types of detectors. Sequential MS/MS Mass Spectrometry. Coupling Mass Spectrometers with chromatographs (GC/MS, HPLC/MS). MRM (Multiple Reaction Monitoring) technique. Modern Applications of Mass Spectrometry in Proteomic Analysis.

HIGH-PERFORMANCE CAPILLARY ELECTROPORATION (CE) AND BIOANALYZERS: Principles of CE, organology. Modes of operation in CE. Separation mechanisms and methods and physicochemical characteristics. Quantification and applications of CE. Operating principle of Bioanalyzers and their applications to biomolecules. Multiplex analysis. Principles, coupling of molecules in beads and applications.

ANALYTICAL DETERMINATIONS OF COMPONENTS BY SOLID-PHASE METHODOLOGIES: Determination of proteoglycans/glycosaminoglycans. Interactions of proteoglycans with proteins. Determination of enzymes acting on macromolecular substrates and providing a mixture of final products. Application of the methodologies to the pathogenesis of diseases.

MICROSCOPY TECHNIQUES: Principles of scanning and transmission electron microscopy (SEM /TEM).

Fluorescence microscopy. Confocal microscopy. Advanced Functional Microscopy Techniques. Applications in biological systems.

4. TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY</td><td colspan="2">Face to face. Distance learning</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td colspan="2">Use of ICT (powerpoint) in teaching
Use of ICT in the communication with the students</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (4 hours / week for 6 weeks)</td><td>24</td></tr>
<tr><td>Final examination</td><td>3</td></tr>
<tr><td>Private study of the course material throughout the lecturing period
Preparation of the team work and for the final oral examination</td><td>98</td></tr>
<tr><td>Course total
(25 hours total workload for each</td><td>125</td></tr>
</table>
</td><td></td></tr>
</table>

	ECTS credit)		
STUDENT PERFORMANCE EVALUATION	1. Written examination after the end of the semester. Minimum passing grade: 5/10. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A 2. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course. 3. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam.		

5. RECOMMENDED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Principles of Instrumental Analysis, A. Skoog, F. James Holler, S. R. Crouch, Cengage Learning 2006, ISBN 978-0495012016
2. Notes of lecturers.

- *Related academic sources and journals:*

Scientific articles used in teaching are available.

COURSE OUTLINE "RESEARCH METHODOLOGY"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRADUATE (MSc)		
COURSE CODE	REM 201	**SEMESTER**	SECOND
COURSE TITLE	RESEARCH METHODOLOGY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
Seminars	2	5

COURSE TYPE	Special Background (Semi-optional course)
PREREQUISITE COURSES:	There are not prerequisite courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be performed in English in case of foreign students participate in the postgraduate program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes

At the end of this course student should be able to:

Combine knowledge through selected scientific and research seminars from the sciences of Chemistry and Medicine (interdisciplinary) and which includes the application of techniques and tools applied to research for the development of innovative bioactive compounds for pharmaceutical interest.

General Competences

By the end of this course the student will, furthermore, have developed the following skills (abilities):

- Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related to the Medicinal Chemistry and Chemical Biology, an area of research in which chemical, medicine and biological concepts and tools interact synergistically in the pursuit of new discoveries and/or technologies.
- Ability to apply this knowledge and understanding to solve problems related to Medicinal Chemsitry and Chemical Biology of non-familiar nature
- Study skill needed for continuous professional development
- Ability to interact with others in solving problems of chemical/biochemical or multidisciplinary nature

Generally, by the end of this course the student will have developed the following general abilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently

- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment

3. SYLLABUS

Presentation of selected seminars, research topics and techniques related to Medical Chemistry and Chemical Biology (development of pharmaceutical products):

- Chemical information in the internet.
- Clean rooms in the pharmaceutical industry: theory and practice – regulations.
- Ethics for clinical trials.
- Clean rooms in the pharmaceutical industry: Application: standard production line for aseptic injectors in a clean room.
- Pharmaceutical technology: Lyophilization.
- Quality assurance analysis.
- Preclinical evaluation towards to clinical trials.
- Epidemiology principles and research plans.
- Methodology for writing and presenting research results.
- Chemical Risk Assessment.

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of ICT (powerpoint) in teaching and in the communication with the students.
TEACHING METHODS	

Activity	***Semester workload***
Lectures	32
Private study of the seminars throughout the lecturing period.	93
Course total ***(25 work load for each ECTS credit)***	***125***

STUDENT PERFORMANCE EVALUATION	The final grade is in conjunction with the Student's Postgraduate Thesis (course group) and is determined by the three-member Examination Committee designated by the Interdepartmental Committee of the program. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades, the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A Teaching is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course.

5. RECOMMENDED BIBLIOGRAPHY *(apart from the literature provided during each lecture)*

In each lecture-seminar, bibliography is suggested by the Teachers to the Postgraduate Students.

COURSE OUTLINE "CHEMICAL BIOLOGY"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRADUATE (MSc)		
COURSE CODE	CHB 202	**SEMESTER**	SECOND
COURSE TITLE	CHEMICAL BIOLOGY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	5

COURSE TYPE	Special Background (Semi-optional course)
PREREQUISITE COURSES:	There are not prerequisite courses. It is, however, recommended that students should at least have basic knowledge of Organic Chemistry and Biochemistry.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is however in English. Teaching may be performed in English in case of foreign students participate in the postgraduate program.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes
At the end of this course student should be able to: • Apply the chemical biology approach, which often starts with the analysis of a biological phenomenon in order to deduce structural information, for instance about biomacromolecules or small molecules which interact with them. Whereas traditional disciplines, such as organic chemistry and biochemistry, have a vertical focus, applying techniques to discipline specific questions, chemical biology has a more horizontal focus, borrowing tools from organic chemistry, biochemistry, analytical chemistry, molecular biology, structural biology and/or cell biology to study biological questions at the molecular level. • On the basis of this information, unsolved chemical / biological problems are identified and the ability of the synthetic chemist to design and prepare tailor-made reagents and tool compounds, that is proteins equipped with reporter groups and tags or potent and selective small molecule modulators of protein functions and interactions, is employed as key enabling technology for subsequent research. • To determine the biochemical and biophysical properties of these reagents for the proper design and execution of biological experiments, giving new insights into the originally motivating biological phenomenon.
General Competences
By the end of this course the student will, furthermore, have developed the following skills (abilities): • Ability to demonstrate knowledge and understanding of the essential facts, concepts, theories and applications related to the Chemical Biology, which is an area of research in which

chemical and biological concepts and tools interact synergistically in the pursuit of new discoveries or technologies.

- Ability to apply this knowledge and understanding to solve problems related to the Chemical Biology of non-familiar nature
- Ability to apply this knowledge for understanding other biological processes
- Ability to adopt and apply methodology for solving non-familiar problems
- Study skill needed for continuous professional development
- Ability to interact with others in solving problems of chemical/biochemical or multidisciplinary nature

Generally, by the end of this course the student will have developed the following general abilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment

3. SYLLABUS

Lectures of selected studies-cases (CS, case-studies) of Chemical Biology such as:

- NATIVE CHEMICAL LIGATIONS-A TOOL FOR CHEMICAL PROTEIN SYNTHESIS
- CLICK CHEMISTRY IN CHEMICAL BIOLOGY
- THE INTRODUCTION OF CHEMICAL REPORTER GROUPS BY BIO-ORTHOGONAL LIGATION REACTIONS FOR THE IMAGING OF CELL-SURFACE GLYCANS
- THE USE OF PHOTOAFFINITY LABELING FOR THE IDENTIFICATION OF THE BINDING SITE OF THE ANTIBIOTIC LINEZOLID
- NUCLEIC ACIDS-BASED THERAPEUTICS: FROM SMALL MOLECULE MODULATORS TO GENE THERAPY APPROACHES
- THE CASE OF STI571 (GLIVEC) SUSPENSION IN PDGFR AND C-KIT SUSPENSION IN CHRONIC MELLIGNATIVE MATHEMATICS (CML) AND GASTRIC GASTRIC
- AROMATHASES IN THE TREATMENT OF HORMONOLOGY BREAST CANCER
- MODULATION OF PROTEIN-PROTEIN INTERACTIONS BY SMALL MOLECULES
- MICROARRAY-BASED STRATEGIES TO IDENTIFY UNKNOWN PROTEIN INTERACTIONS
- REAL-TIME AND CONTINUOUS SENSORS OF PROTEIN KINASE ACTIVITY UTILIZING CHELATION-ENHANCED FLUORESCENCE
- SELECTIVE TARGETING OF PROTEIN INTERACTIONS MEDIATED BY BET BROMODOMAINS

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning		
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of ICT (powerpoint) in teaching and in the communication with the students.		
TEACHING METHODS	***Activity***	***Semester workload***	

	Lectures	32
	Final examination	6
	Private study of the course material throughout the lecturing period. Collaborative problem-solving work by the students working in teams of two, following the end of lecturing period. Preparation for the final examination.	87
	Course total ***(25 work load for each ECTS credit)***	***125***
STUDENT PERFORMANCE EVALUATION	1. Following the end of the lecture period, a collaborative problem-solving work from the Chemical Biology research area (including synthetic organic chemistry, biochemistry, structural biology, pharmaceutical chemistry) is presented (using ICT) by each pair of students. This work includes two problems – the chemical and the biological - based on the taught material. 2. Oral examination on the material of the work of each student individually by a three-member committee. The committee evaluates the quality of the ICT, the presentation and the overall performance of each student. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades ≤ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades, the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and ≥ 9 = A 3. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course.	

5. RECOMMENDED BIBLIOGRAPHY *(apart from the literature provided during each lecture)*

1. H. Waldmann, P. Janning, “Chemical Biology: Learning through Case Studies”, Eds., Wiley-VCH, Weinheim, 2009.
2. H. Waldmann, P. Janning, “Concepts and Case Studies in Chemical Biology”, Eds., Wiley-VCH, Weinheim, 2014.
3. H.C. Kolb, M.G. Finn, and K. Barry Sharpless, ‘Click Chemistry: Diverse Chemical Function from a Few Good Reactions’*, Angew. Chem. Inter. Ed.*, 2001, *40*, 2004-2021 and references cited therein.
4. C.R. Becer, R. Hoogenboom, and U.S. Schubert, ‘Click Chemistry beyond Metal-Catalyzed Cycloaddition’*, Angew. Chem. Inter. Ed.*, 2009, *48*, 4900-4908 and references cited therein.
5. a) C.R. Bertozzi et al, *J. Am. Chem. Soc.*, 2008, *130*, 11486-11493; b) C.R. Bertozzi et al, *J. Am. Chem. Soc.*, 2010, *132*, 3688-3690 and references cited therein.
6. G.J. Boons et al, *Angew. Chem. Int. Ed.*, 2008, *47*, 2253-2255.
7. J.M. Fox et al, *J. Am. Chem. Soc,* 2008, *130*, 13518-13519.
8. K.N. Houk et al, *J. Am. Chem. Soc,* 2012, *134*, 17904-17907.

COURSE OUTLINE "BASIC AND TRANSLATIONAL IMMUNOLOGY"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF COURSE	POSTGRADUATE (MSc)		
COURSE CODE	BTI 217	**SEMESTER OF STUDIES**	SECOND
COURSE TITLE	BASIC AND TRANSLATIONAL IMMUNOLOGY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS CREDITS**
Lectures	2	5
Seminars	1	
Laboratory exercises	1	

COURSE TYPE	Fields of Science (Immunology) and Skills Development (perform and interpret experiments, learning immunological methods, learning to write scientific articles). (Semi Optional)
PREREQUISITE COURSES:	Basic Cell Biology
TEACHING AND ASSESSMENT LANGUAGE:	Greek. Teaching may be done in English if foreign students attend the program.
IS THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes
At the end of the course the students will have: • Knowledge of current topics of basic and translational immunology. • Knowledge of the types of immunotherapies already applied to patients or they're being developed. • Knowledge and ability to plan experiments to solve problems related to immune disease pathogenesis. • Immune experimental methodology such as HLA typing, phenotypic analysis of immune cells, measurement of the concentration of cytokines and other proteins in peripheral blood and bodily fluids, and in cell culture supernatants. • Learn how to write scientific articles in immunology topics.
General Competences
By the end of this course the student will, furthermore, have developed the following skills (abilities): • Ability to solve theoretical and practical problems requiring the application of combined skills. • Skills that will allow him/her to solve simple and complex problems. *Generally by the end of this course the student will have developed the following general*

abilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Team work
- Decision-making
- Working independently
- Criticism and self-criticism
- Production of free, creative and inductive thinking

3. SYLLABUS

The cells of the immune system - types, functions, communication
Immune tolerance
Antibodies - types, functions
Vaccines
The HLA system
Malfunctions of the immune system:

- Hypersensitivity reactions
- Autoimmune diseases
- Neoplasias

Immunology of transplantation
The immune system and HIV/AIDS
Immunomodulation:

- Interventions at the molecular and cellular level
- Therapies with antibodies, artificial antigens (peptides)
- Transplantation of hematopoietic stem cells

Laboratory

- Learning peripheral blood cell phenotyping using flow cytometry and analysis of the results
- Small laboratory project entailing culture of peripheral blood cells, methods for isolation of cell populations, measurement of cytokine expression and secretion levels in isolated cell populations
- Learning HLA typing by PCR methods
- Learning to write scientific articles on an immunological topic

4. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY	Face to face. Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Lectures and tutorials using ICT (powerpoint). Laboratory education.
TEACHING METHODS	

Activity	***Semester workload* (contact hours)**
Lectures	26
Seminars	13
Laboratory	13
Final examination	3
Student's study hours for learning activity	70

	Course total (25 work load for each ECTS credit)	***125***
STUDENT PERFORMANCE EVALUATION	1. The students get a grade at the end of the course with one of the following evaluation methods: • The students are given 10 questions of which they have to answer 5 and hand in their answers within 2 weeks. • If the students opt to try and write a paper, they have to hand in their paper within 4 months to be evaluated. • Student attendance is taken into consideration for the final mark. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades $\leq$ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and $\geq$ 9 = A 2. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course. 3. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam.	

5. RECOMMENDED BIBLIOGRAPHY

- *Suggested bibliography:*

Textbook: Lippincott's Illustrated Reviews: Immunology", 2nd Edition by T. Doan, R. Melvold, S. Viselli, C. Waltenbaugh, 2014 (ISBN: 978-960-394-986-2). Responsible for the Greek Edition: Athanasia Mouzaki.

- *Related academic sources and journals:*

All scientific articles used in teaching and, also, all articles the students require if they write a report or paper are made available to them.

COURSE OUTLINE "PHARMACOLOGY (MECHANISMS – TARGETS FOR PHARMACOLOGICAL INTERVENTION)"

1. GENERAL

SCHOOL	NATURAL SCIENCES AND HEALTH SCIENCES		
ACADEMIC UNIT/PARTICIPATING UNITS	UNIVERSITY OF PATRAS / DEPARTMENTS OF CHEMISTRY (running) AND MEDICINE		
LEVEL OF STUDIES	POSTGRADUATE (MSc)		
COURSE CODE	PHA 218	**SEMESTER**	SECOND
COURSE TITLE	PHARMACOLOGY (MECHANISMS – TARGETS FOR PHARMACOLOGICAL INTERVENTION)		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5

COURSE TYPE	Special Background (Semi-optional course)
PREREQUISITE COURSES:	There are not prerequisite courses. It is however recommended that students should at least have basic knowledge Genetics and Molecular Biology.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. The powerpoint material of the course is in English. Teaching and examinations may be performed in English in case foreign students participate in the postgraduate program
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	-

2. LEARNING OUTCOMES

Learning outcomes

At the end of this course the MSc student should be able to:

- Know and understand topics of clinical and molecular pharmacology.
- Understand the mechanisms that cause various diseases.
- Understand the objectives of pharmacological intervention in various diseases.

General Competences

By the end of this course the MSc student will, furthermore, have developed the following skills (abilities):

- Ability to demonstrate knowledge and understanding of the essential data, concepts, theories and applications related to pharmacology (molecular & clinical) and the mechanisms governing various diseases.
- Ability to adopt and apply methodology to the solution of problems related to the subject of pharmacology.
- Study skills needed for continued professional development.
- Ability to understand the essential concepts and principles related to human diseases and ways of pharmacological intervention and treatment.
- Ability to interact with colleagues in other disciplines to solve interdisciplinary problems

Generally, by the end of this course the MSc student will have developed the following general

abilities:
To target the cause of a disease and intervene to address it.

The MSc student has also acquired the basic skills in the following general competencies:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment
- Production of new research ideas

3. SYLLABUS

The course focuses on the basic principles of Pharmacology, focusing on the mechanisms of various diseases and the pharmacological intervention to address them.

In particular the following topics are included:

- Receptor plasticity as a basis for designing new types of drugs. From the conventional to the modern pharmacology.
- From chemicals to biological drugs – Generic drugs.
- Ion channels, transporters, enzymes, DNA, cell wall and membranes as targets for pharmacological intervention.
- Immunopharmacological interventions in cancer.
- Side effects and drug safety - Pharmacovigilance.
- Bioequivalence studies, clinical trials and introduction of new drugs.
- Specific topics (multiple sclerosis, anticoagulants, hypolipidemic, iostatic, etc.).

4. TEACHING and LEARNING METHODS – EVALUATION

<table>
<tr><td>DELIVERY</td><td>Face to face. Distance learning</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of ICT (powerpoint) in teaching
Use of ICT in the communication with the students</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Final examination</td><td>2</td></tr>
<tr><td>Study the course material throughout the course.
Preparation of the presentation by groups of two students when the lectures are completed.
Preparation for final examination.</td><td>97</td></tr>
<tr><td>Course total
(25 work load for each ECTS credit)</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>1. Upon completion of the lectures, each pair of students prepares a powerpoint presentation on a selected topic of the course subject. Following is a presentation and an oral examination of the</td></tr>
</table>

	work individually for each student and it is evaluated. Greek grading scale: 1 to 10. Minimum passing grade: 5. Grades $\leq$ 3 correspond to ECTS grade F. Grade 4 corresponds to ECTS grade FX. For the passing grades the following equivalence normally holds with the ECTS passing grades: 5 = E, 6 = D, 7 = C, 8 = B and $\geq$ 9 = A 2. Teaching and examination is delivered normally in Greek. Powerpoint slides are, however, in English. Instruction and examination may be given in English, if foreign students attend the course. 3. Oral examination will be possible in certain cases (students certified that cannot participate in written examinations) at the same day and time with that of the exam.

5. RECOMMENDED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Greek or foreign language books on Pharmacology, Clinical Pharmacology and Molecular Pharmacology.
2. Scientific literature related to course lectures.

- *Related academic sources and journals:*

1. Christodoulos S. Flordellis, "*The Plasticity of the 7TMR Signaling Machinery and the Search for Pharmacological Selectivity*'', Current Pharmaceutical Design, 2012, 18, 145-160.
2. Iason Kyriazis, John Ellul, Paraskevi Katsakiori, George Panayiotakopoulos and Christodoulos Flordellis, "*The Multiple Layers of Signaling Selectivity at Protease-Activated Receptors*'', Current Pharmaceutical Design, 2012, 18, 161-174.

Selected Lectures - Seminars in the context of Research Methodology
MSc: Medicinal Chemistry and Chemical Biology"

a/a	Seminar Title	Teacher/Lecturer
1	Chemical information in the internet	**Prof. Constantinos Athanassopoulos**, Department of Chemistry, University of Patras Email: kath@chemistry.upatras.gr
2	Click Chemistry	**Emeritus Professor Dionysios Papaioannou** Department of Chemistry, University of Patras Email: dapapaio@upatras.gr
3	Clean rooms in the pharmaceutical industry: Part 1, (theory and practice - regulations)	**Konstantinos Kagkadis,** CBL Patras (Chemical and Biopharmaceutical Laboratories) Email: kagkadisk@cblpatras.gr
4	Clean rooms in the pharmaceutical industry: Part 2, (Application: standard production line for aseptic injectors in a clean room)	**Konstantinos Kagkadis,** CBL Patras (Chemical and Biopharmaceutical Laboratories) Email: kagkadisk@cblpatras.gr
5	Pharmaceutical technology. Part 1: Lyophilization	**Konstantinos Kagkadis,** CBL Patras (Chemical and Biopharmaceutical Laboratories) Email: kagkadisk@cblpatras.gr
6	Pharmaceutical technology. Part 2: Lyophilization	**Konstantinos Kagkadis,** CBL Patras (Chemical and Biopharmaceutical Laboratories) Email: kagkadisk@cblpatras.gr
7	Tandem Reactions in Organic Synthesis	**Emeritus Professor Dionisios Papaioannou** Department of Chemistry, University of Patras Email: dapapaio@upatras.gr
8	**Two Lectures** Pre-clinical evaluation towards to clinical trials	**Efstathia Giannopoulou, PhD** Investigator Initiated Study Specialist, EXCELYA S.A. Email: egiannopoulou@excelya.com
9	**Two Lectures** **1st:** Introduction to Clinical Trials: Moral and ethical issues **2nd:** Clinical Trials Sustainability Plan – Design of Clinical Trials	**Dimitrios Lagos,** Feasibility Manager, Global Operations, EXCELYA S.A. Email: dlagos@excelya.com
10	**Four Lectures:** Methodology for writing and presenting research results	**Efstathia Koulouri, EDIP, PhD** Department of Chemistry, University of Patras Email: e.koulouri@chemistry.upatras.gr
11	**Two Lectures:** Epidemiology principles and research plans.	**Prof. Eleni Jelastopulu,** Department of Medicine, University of Patras Email: jelasto@upatras.gr
12	**Two Lectures:**	**Vana Kalaitzi,**

	Quality assurance analysis.	CBL Patras (Chemical and Biopharmaceutical Laboratories) Email: vkalaitzi@cblpatras.gr
13	Quality control in pharmaceutical industry	**Sofia Oikonomopoulou, PhD** Third Party Quality Operations Senior Manager Pharmathen S.A. Email: soikonomopoulou@pharmathen.com