Course Title	**Molecular Pharmacology**				
Course Code	PHA306				
Course Type	Compulsory				
Level	BSc (Level 1)/ MPharm (Level 2)				
Year / Semester	3st / 5th Semester				
Teacher's Name	Dr Panagiotis Theodosis-Nompelos				
ECTS	6	Lectures / week	3	Laboratories/week	2
Course Purpose	The basic aim of this course is to teach the students the molecular and biochemical basis of drug action. Another aim is the clarification of the mode of drug - receptor interactions, as well as the nature of them. Further aim is the kinetics and dynamics of these interactions, as well as the knowledge of the cellular, biochemical and molecular aspects of phenomena like drug metabolism, free radicals and oxidative stress.				
Learning Outcomes	Students are expected to: • Recognize and explain the relationship of Molecular pharmacology with other biological sciences and its contribution to the progress of health sciences in general and in particular its relevance to Pharmacology and Pharmacochemistry. Application examples. • Be familiarized with basic concepts of Biochemistry and molecular processes: Structure of macromolecules (proteins, carbohydrates, lipids, nucleic acids) i.e. which are also the targets of medicines. • Predict the types of bonds and binding strengths of pharmaceutical molecules on their targets. • Describe the nature of enzymes, their active site and the types of drug interactions with it (substrates, inhibitors, allosteric modifiers). • Know the molecular role of neurotransmitters and hormones. • Have a clear understanding of induced adaptation (change in receptor conformation) and structural requirements of the drug (ligand). • Analyse the concept of receptor desensitization, sensitization, tolerance and dependence. • Explain the kinetics of drug – receptor interactions. • Analyze Quantitative parameters: Drug effect with dose/concentration relationships for agonists, antagonists, inverse agonists. • Explain the structure and function (message transduction) of the 4 major receptor superfamilies. Typical examples. • Explain the action of drugs on DNA-RNA. • Describe how drug-receptor interaction is affected by characteristic chemical groups and how their modification can improve this interaction. • Analyse the basic molecular and chemical concepts for phenomena such as drug metabolism, biological and oxidative stress as well as the antioxidant activity of pharmacomolecules.				
Prerequisites	PHA207			Corequisites	None

Course Content	**Theory** Molecular and biochemical aspects of drug action. Mechanisms of drug action at cellular and molecular level. Drug receptors, nature and structure, drug-receptor interactions, mechanisms of cellular process activation, how the message is received. Action of drugs on proteins. Types of drug-receptor (drug-enzyme) interactions. Agonists, antagonists, partial and inverse agonists. Allosteric modulators. Ion channels, G-protein coupled receptors. Kinase coupled receptors, Intracellular receptors. Action of drugs on enzymes. Modulation of enzyme activity, isozymes. Neurotransmitters, hormones. Drug action on DNA, RNA. Applications of molecular biology and genetic engineering in pharmacy. Stereochemical factors in pharmacological action. Drug molecules with improved action on receptors. Drugs acting without interaction with receptors. Molecular pharmacology of free radicals. Oxidative stress and resistance of the organism. Antioxidant compounds and mechanisms. Cell death, cell necrosis, cell apoptosis-programmed cell death. Drug metabolizing enzymes. Methods of studying metabolism. Fate of drug molecules in the organism. **Laboratory work** Exercises on the course subject are included: Exercise 1: In silico evaluation of binding of drugs on various receptors Exercise 2: Determination of important biological markers in serum (SGOT, SGPT, LDH, BUN) and liver (glutathione) and their importance. Exercise 3: Analysis of the hepatoprotective effect of N-acetylcysteine and 4- methylpyrazole in cases of paracetamol toxicity. Exercise 4: Quantification of catalase action in various tissues Exercises 5: Metabolism of erythromycin and 4-nitrophenol by liver microsomes. Analysis of metabolism inhibitory compounds. Exercise 6: Isolation and oxidation of liver microsomal membranes and determination of the action of antioxidants Exercises 7-8: Assessment of the antioxidant activity of pharmaceutical compounds, by their ability to interact with the stable DPPH free radical

Teaching Methodology	Teaching methodology includes lectures, case studies and problem solving tutorials to offer the theoretical background and exercises in order to better understand the aspects of molecular mechanisms of action. Detailed notes

	with PowerPoint are used in the lesson. Image-rich material and short animations are used to comprehend the various biological processes. Methods such as discussion, questions/answers, pros/cons and debates are used to enhance student's participation. Additionally, recent research findings are presented in the course content.
Bibliography	Textbooks: 1. «Μοριακή Φαρμακολογία», Α. Κουρουνάκη, Πανεπιστήμιο Αθηνών, 2017. 2. "General and Molecular Pharmacology: Principles of Drug Action", F. Clementi, G. Fumagalli, Wiley, 2015. 3. «Μοριακή Φαρμακολογία», Ε. Παπαδημητρίου, Εκδόσεις ΠΑΡΙΣΙΑΝΟΥ, 2010. 4. «An Introduction to Medicinal Chemistry», Patrick, Graham L. Oxford, 2009. References: 5. «An Introduction to Medicinal Chemistry», Patrick, Graham L. Oxford, 2009. 6. "Foundations of Molecular Pharmacology: Volume 2, Chemical basis of drug action", J.B. Stenlake, Humanities Press Inc. 1992.
Assessment	Mid Term Exam **30%** Lab Reports and Case Study presentation **20%** Final Examination **50%** Course evaluation is done by: (a) a written examination during the semester which examines specific modules of the course and it accounts for 30% of the total grade (b) laboratory reports during the semester, in which students present the collected and analysed experimental data as well as their conclusions, derived from theory and the experimental data, and it accounts for 20% of the total score (c) a final written examination which examines all modules of the course material and it accounts for 50% of the total grade. Students are prepared for the above written exams over the theoretical and practical background in the classroom and with additional exercises given to them for further practice. For the better comprehension of the subject frequent revisions are performed at regular intervals. Questions of gradual difficulty apply to the evaluation of the mid-term and final examination. There may be multiple choice or right/wrong questions with justification of the answers or issue analysis and problem solving questions may be applied in order to evaluate the knowledge and perception of the student on the subject. For the evaluation of laboratory exercise reports, the following criteria shall be taken into account, with ratios varying according to the laboratory exercise: (a) data collection (b) data analysis (c) application of theory to draw conclusions

	The above criteria and assessment tools, as well as their weight, are communicated to the students, and are formulated in such a way in order to maximize the expected learning outcomes as well as the quality of the course.
Language	Greek, English