**UNIVERSITY OF PATRAS**
**SCHOOL OF HEALTH SCIENCES**
**DEPARTMENT OF PHARMACY**
**UNDERGRADUATE STUDIES' COURSES**

COURSE DESCRIPTION: **BIOPHARMACEUTICS - PHARMACOKINETICS**
COURSE CODE: **PHA-D21-NEW**

**BIOPHARMACEUTICS - PHARMACOKINETICS**
**COURSE DESCRIPTION**

## 1. GENERAL

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| **SCHOOL** | HEALTH SCIENCES | | |
| **SEPARTMENT** | PHARMACY | | |
| **LEVEL OF COURSE** | UNDERGRADUATE | | |
| **COURSE CODE** | **PHA-D21-NEW** | **SEMESTER OF STUDIES** | **8th** |
| **COURSE TITLE** | BIOPHARMACEUTICS - PHARMACOKINETICS | | |

| **INDEPENDENT TEACHING ACTIVITIES** | **TEACHING HOURS PER WEEK** | **ECTS CREDITS** |
|---|---|---|
| Lectures | 4 | 7 |
| Laboratory exercises | 4 | |
| Tutorial | 2 | |

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| **COURSE TYPE** | Scientific Field course |
| **PREREQUISITE COURSES:** | - |
| **TEACHING AND ASSESSMENT LANGUAGE:** | Greek |
| **THE COURSE IS OFFERED TO ERASMUS STUDENTS** | Not offered |
| **COURSE WEBPAGE (URL)** | http://www.pharmacy.upatras.gr/images/DS/PHA-D21-EN.pdf |

## 2. LEARNING OUTCOMES

**Learning Outcomes**

The Learning Outcomes of this course corresponding to Level 7, comprise the following:

- Highly specialized knowledge, some of it cutting-edge in the fields of Biopharmaceutics and Pharmacokinetics, as a base for innovative thinking and research
- Critical understanding of the knowledge status in these fields and their interrelationship with other fields
- Specialized skills for problem-solving, necessary in research and/or in innovation, in order to generate novel knowledge and processes
- Management and evolution in changing, unpredictable and complex work environments, requiring novel strategic approaches
- Responsibility for contributing to the enrichment of professional knowledge and practice in the fields

Specifically, following this course:

- Students learn and understand the issues and importance of Biopharmaceutical-Pharmacokinetics and acquire the necessary knowledge to understand how we determine a dosing regimen for a patient for optimal treatment.
- In particular, by using all the knowledge that they have provided in Pharmacy and learning new concepts, they link the release, absorption, distribution, metabolism and elimination of drugs, with optimal pharmacotherapy (maximum efficacy with minimization of toxicity).

- At the end of the course, students are able to use the knowledge and understanding they have gained so that they can in the future (in their professional rehabilitation) better approach the role (profession) of the Clinical Pharmacokinetics / Clinical Pharmacologist / Clinic Toxicologist.
- Students are also able to recognize the great importance of pharmacists, clinicians, laboratory and nursing staff, with the aim of optimizing each patient and adapting the dosage regimen to each patient (personalized treatment).
- Students better understand pathology, explain symptoms, combine information and eventually suggest treatment.
- Finally, students acquire sufficient knowledge to enable them to undertake postgraduate studies in related fields such as Clinical Pharmacy, Pharmacology, Toxicology, etc.

**General Abilities**

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
- Decision making
- Working in a multidisciplinary environment
- Group work

3. **COURSE CONTENT**

Lectures

- Introduction to bioavailability and biopharmaceuticals.
- Introduction to classical and clinical pharmacokinetics.
- Basic principles of pharmacokinetics and pharmacokinetic models.
- One- compartment open model, intravenous bolus administration. Elimination rate constant and its calculation from plasma and urine data. Significance of the Apparent volume of distribution. Drug Clearance.
- Multi-compartmental open model, intravenous bolus administration. Method of Residuals. Apparent volumes of distribution (central-peripheral compartment, Extrapolated, by area) and their significance. Elimination rate constant and drug clearance.
- Intravenous infusion. Steady-State Drug Concentration and Time needed to Reach. Initial dose. The clinical significance of drug clearance and Apparent volume of distribution during intravenous infusion.
- Physiological factors of distribution in the body. Diffusion and hydrostatic pressure.
- Drug distribution in the body. Drug uptake by tissues, blood flow, half-life, apparent volume of distribution.
- Protein binding of drugs. Determinants and kinetics of protein binding. Determination of binding constants and binding sites. Relationship of plasma drug-protein binding to distribution and elimination. Clinical significance of drug- protein binding.
- Drug absorption. Physiological factors associated with absorption. Routes of drug administration. Passage of drugs across cell Membranes.
- Drug absorption following oral administration. Anatomical and Physiological considerations of drug absorption from the gastrointestinal tract.
- Factors and pathological conditions (achlorydria, heart failure, inflammatory disease of intestine, drugs / foods that affect absorption) affect drug absorption.

- Zero and first order absorption models. Determination of absorption and elimination rate constants. Determination of maximum concentration and lag time.
- Other routes of drug administration : intranasal, inhalation, topical and transdermal administration.
- Multiple-dose regiments. Drug accumulation and the principle of superposition. Repetitive oral and intravenous administrations. Loading Dose. Intermittent intravenous infusion.
- Renal drug excretion. The Kidney: anatomy, blood supply, glomerular Filtration and urine formation. Renal clearance, clearance models, determination of Renal clearance. Mechanisms of renal drug excretion.
- Hepatic elimination of drugs. Anatomy and physiology of the liver. Hepatic enzymes and drug metabolism. Drug Biotransformation reactions. Enzymes Kinetics, enzyme inhibition-induction. Metabolites Pharmacokinetics and percentage of non-metabolised drug. Hepatic clearance affected by protein binding, alteration of hepatic enzyme activity, changing blood flow to the liver. First-pass effect. Biliary excretion of drugs.
- Adjustment of dosage regimen to kidney disease. Renal insufficiency and General pharmacokinetic considerations. Glomerular filtration rate: calculation Serum creatinine and creatinine clearance. Principles of dose adjustment to uremia. Methods of personalization of dosage form in kidney disease.Nomograms. Adjustment of dosage regimen during extracorporeal. Drug withdrawal: hemodialysis, peritoneal dialysis, amodifilcation.
- Dose adjustment in patients with liver disease.
- Genetic factors and pharmacokinetics. Introduction to pharmacogenomics- Pharmacogenetics. Genetic polymorphism in drug metabolism, in drug transport, in drug target. Pharmacokinetics and pharmacogenomics-pharmacogenetics.
- Non-linear pharmacokinetics. Introduction to dose-dependent pharmacokinetics.
- Drug elimination by capacity-limited pharmacokinetics.
- Saturable enzymatic elimination processes: dependence of clearance and Half-life on dose. Non-linear pharmacokinetics due to drug-protein binding.
- Chronopharmacokinetics and time-dependent pharmacokinetics.
- Applications of Pharmacokinetics in clinical situations: individualization of drug dosage regimen.
- Determination of initial dose and dosage
- Regiments. Therapeutic drug monitoring. Measurement of levels of the drug in plasma. Determination of dose. Conversion from intravenous infusion to oral dosing.
- Dosing of drugs in children, the elderly and obese patients.
- Pharmacokinetics of drug interactions. Effect of food on drug dispotition.
- Population pharmacokinetics. Regional pharmacokinetics.
- Bioequivalence and bioavailability. Relative and absolute bioavailability.
- Bioequivalence studies. The biopharmaceutics drug classification system.
- Generics and biosimilars drugs.
- Modified-release drug products and pharmacokinetics.
- Targeted drug delivery systems, biotechnology products. Bioavailability-pharmacokinetics.
- Process validation, drug product quality and impact on drug bioavailability.
- Relationship between Pharmacokinetics and pharmacodynamics. Relationship between dose and half-life on the pharmacologic effect and duration of activity.

Tutorial

- Summarize useful mathematical relations, classes of reactions,linear analysis, least squares method.
- Use of pharmacokinetics models and design compartmental models.
- Measurement the amount of drug in the body and tissues and concentration using compartmental pharmacokinetic models.
- Drug absorption after oral administration. Exercises to alter absorption due to food intake or other medications.
- Determination of half-life, elimination rate constant, volume of drug distribution and clearance of plasma and urine concentration data.

- Determination of intravenous infusion rate and loading dose.
- Modification of dosage regimen when protein synthesis and binding change.
- Personalized dosage regimen in patients with renal failure: based on renal clearance or elimination rate constant of the drug.
- Determination of dose and dosage interval during multiple-dose regimen.
- Dosing of drugs in infants, children and the elderly.
- Modification of dosage regimen when pharmacokinetics is converted to non-Linear.
- Pharmacokinetic- pharmacodynamic models with an effect compartment.
- Hysterisis of pharmacologic response.
- Multiple-dose regiments. Calculation of the new dosage regimen in case of missed dose or when one of the drug dose is taken earlier or later than scheduled.

Laboratory exercises

- Protein binding of drugs. Quantitative and qualitative determination of various active ingredients binding to proteins using chromatography.
- Kinetics simulation using compartmental models
- Bioavailability of drugs according to EMEA guidelines. Processing data from clinical bioavailability and bio-equivalence studies between generic and brand name drugs.

## 4. TEACHING AND LEARNING METHODS - ASSESSMENT

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| **Teaching method** | Lectures, laboratory exercises and tutorial work face to face. |
| **Use of information and communication technologies** | Through a web site of the Department of Pharmacy and e-class platform. |
| **Teaching organization** | ***Teaching Method*** — ***Semester Workload***<br>Lectures — 52<br>Laboratory exercises — 26<br>Tutorial — 52<br>Autonomous study — 45<br><br>***Total number of hours for the Course***<br>**(25 hours of work-load per ECTS credit) — 175** |
| **STUDENT ASSESSMENT** | • Written examination at the end of the courses including topic development, answers to multiple choice questions and exercise solving.<br>• Laboratory exercises, report with the results of the exercises and written examinations at the end of each exercise.<br>• The final score is about 80% from the grade of the written examination and 20% from the grade of the laboratory |

## 5. RECOMMENDED LITERATURE

***Relevant Scientific Journals***

According to "Eudoxus" and as mentioned at the end of Student Notes (Bibliography)