UMF
UNIVERSITATEA DE
MEDICINĂ ŞI FARMACIE
IULIU HAŢIEGANU
CLUJ-NAPOCA

Master in Pharmaceutical Industry

- professional and scientific research postgraduate study program -

— university year 2023 - 2024 —

Faculty of Pharmacy
Department of Pharmaceutical Technology and Biopharmacy

Study program presentation brochure

Short description

Main objective: training specialists for the pharmaceutical industry.

Mission: supporting the development of the Romanian pharmaceutical industry through postgraduate, theoretical and practical training of specialists with multidisciplinary grounding, to be able to successfully practice in the development, manufacture, analysis and evaluation of industrial drug products.

The PHARMACEUTICAL INDUSTRY master's program's profile focuses on the scientific, technological, legislative and administrative aspects regarding the manufacture of industrial drug products. The students are provided with in-depth training in the fields of drug formulation, technological and analytical drug development, manufacture and quality evaluation of industrial drug products, as well as with orientation towards scientific research related to technological development, analytical development or clinical evaluation of industrial drug products. Other issues that are addressed in - depth in this master's program are the preparation of the documentation for obtaining a marketing authorization of a pharmaceutical drug product and the European regulations on Good Manufacturing Practice.

In order to provide professional training *in-line* with current requirements, this program was developed in close collaboration with the pharmaceutical industry. Furthermore, industry experts have been co-opted as associate teachers for holding courses and lectures for students.

Number of available positions: 30

For Whom?

⇒Graduates of pharmacy, medicine, biology, chemistry, physics, engineering or mathematics who work or wish to work in the pharmaceutical industry.

⇒Activity fields: research and development; industrial manufacturing of drug products; drug manufacturing, excipient manufacturing, drug product quality control; quality assurance in the pharmaceutical industry; drug product registration; clinical trials and post-marketing surveillance; drug manufacturing management.

Why?

⇒Developed and done in collaboration with the pharmaceutical industry!

⇒Adapted to current professional training needs!

⇒The only master's program in Romania that provides specialized training for the pharmaceutical industry.

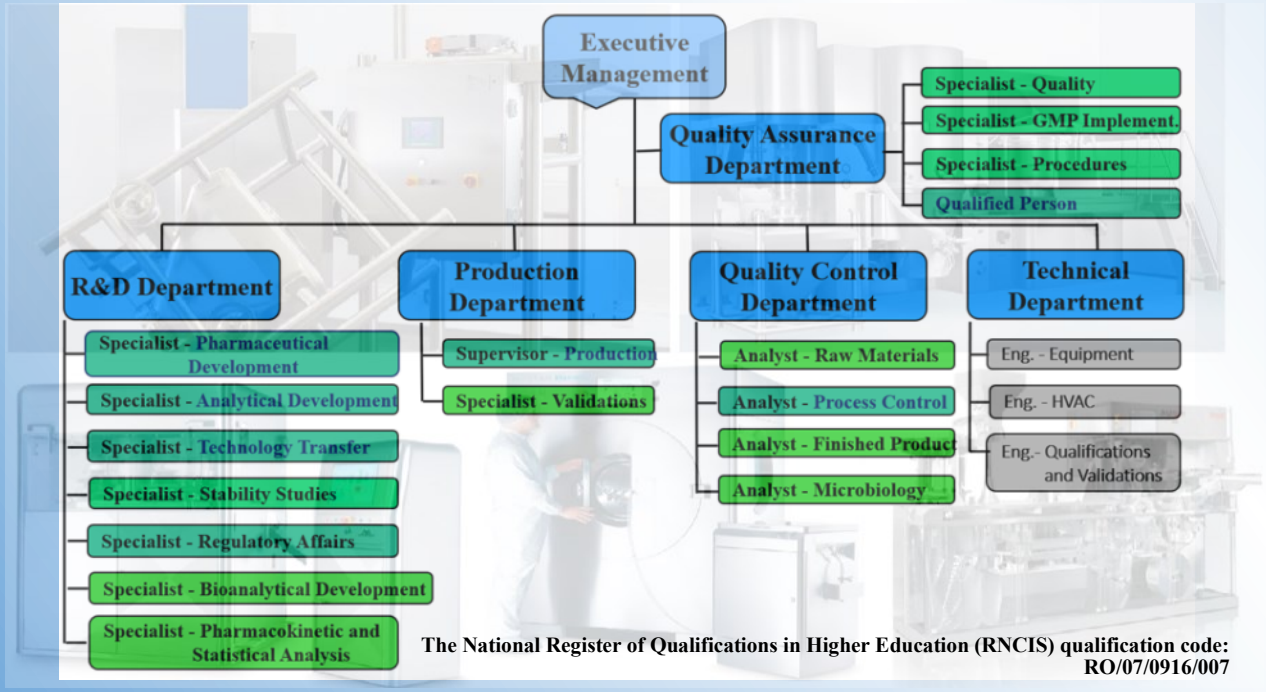
⇒Practice at our pharmaceutical industry partners: Antibiotice, Sandoz Romania, Gedeon Richter Romania, Terapia, PlantExtract, Helcor, Rompharm, Laropharm, STADA Romania, VimSpectrum;

⇒Erasmus mobility at our partners from industry and universities across the European Union.

⇒Certain courses and lectures held by Erasmus invited professors from the European Union.

⇒**After graduation, a master's degree of *industrial pharmacy specialist* is obtained.**

Job opportunities - suitable positions in the pharmaceutical industry after graduation



The National Register of Qualifications in Higher Education (RNCIS) qualification code: RO/07/0916/007

Course topics

1st year

1st Semester

1. Pharmaceutical Drug Development	7 ECTS credits
2. Experimental Research Methodology	7 ECTS credits
3. Pharmacokinetics in Drug Development and Evaluation	7 ECTS credits
4. Academic Ethics and Integrity	4 ECTS credits
5. *Drug Chemistry** or *Drug Design, Discovery and Synthesis**	5 ECTS credits

2nd Semester

1. Analytical Drug Development	6 ECTS credits
2. Industrial Drug Manufacturing I	7 ECTS credits
3. Quality Assurance and Good Manufacturing Practice	7 ECTS credits
4. Drug Bioavailability and Bioequivalence	5 ECTS credits
5. *Pharmaceutical Technology I** or *Biopharmaceutical Drug Manufacturing**	5 ECTS credits

2nd year

3rd Semester

1. Industrial Drug Manufacturing II	7 ECTS credits
2. Drug Quality Control	6 ECTS credits
3. Drug Regulatory Affairs	6 ECTS credits
4. Statistics and Multivariate Experimental Data Analysis	6 ECTS credits
5. *Natural Products - from isolation to dosage forms** or *Pharmaceutical Technology II **	5 ECTS credits

4th Semester

1. Intellectual Property in the Pharmaceutical Field	5 ECTS credits
2. Dissertation Thesis Preparation	20 ECTS credits
3. Professional Practice	5 ECTS credits

ECTS - European Credit Transfer System; * - optional courses, the students must follow one of them

Admission

Application:

Period: July 10-19th, 2023

Location: Faculty of Pharmacy,
4 Louis Pasteur Street, 2nd floor, 400349 Cluj-Napoca
Tel: +40-264-406-845
online / www.umfcluj.ro

Email: decanat_farma@umfcluj.ro
master.industrie@elearn.umfcluj.ro

Requirements for the applicant to be eligible:
Minimum 180 ECTS in bachelor studies (BA/Bsc/BEng) in science or technology: pharmacy, medicine, biology, chemistry, physics, engineering, mathematics, etc.

The content of the application file:

- Application form
- Bachelor studies diploma (or equivalent)
- Bachelor studies transcripts form (or equivalent)
- English proficiency certificate minimum B2 (*or other document to prove English proficiency*)
- Photocopy of identity card / passport
- Photocopy of birth certificate
- Photocopy of marriage certificate (if necessary)
- Medical certificate
- 4 passport size photographs (¾ cm)
- Photocopy of the payment document of the application processing fee
- Europass CV (in English)
- Theoretical report/research project (written in English) - for detail see admission procedure
- Personal data processing agreement
- Envelope file

Admission exam (*interview with the admission committee*):

Date: July 21th, 2023; Hour 2.00 PM

Location: Faculty of Pharmacy
Department of Dermatopharmacy and Cosmetology,
12 Ion Creangă Street, 400010 Cluj-Napoca

Admission procedure:

Two tests: written theoretical report/research project (test 1) + interview with the admission committee (test 2).

Final admission grade*: 30% test 1
70% test 2

** minimum admission grade 6,00 and minimum grade of each test 5,00.*

Test 1: a theoretical report/research project written in English of 3 -6 pages (1600-3000 words) with topics on industrial drug manufacturing or related fields. Report/project will be prepared in advance and included in the application file.

Evaluation criteria of test 1:

a) the topic and the argumentation of its selection	20%
b) the objectives pursued and the originality	40%
d) the scientific accuracy and the clarity of presentation	40%

Test 2: an interview held with the admission committee. *The applicant will present the report/project enclosed in the application and the elements that recommend it for his professional development through this master's program*

Evaluation criteria of test 2:

a) the originality/innovation of the report/project	25%
b) the candidate's motivation to follow this study program and previous connections with the pharmaceutical industry	25%
c) the presentation quality and the communication skills	25%
d) the previous studies of the candidate in the field	25%

**** For international candidates, from non-EU countries, admission to the Master's programme is based on the evaluation of documents attesting to academic performance and personal achievements.**

Tuition fee

Romanian and European Union citizen students

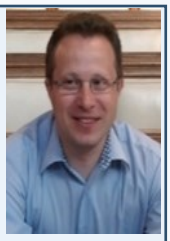
1. Application processing fee 300lei
2. Enrolment/matriculation fee 150lei
3. Annual tuition fee 5000lei (2500lei/semester)
4. Re-examination fee 100lei/exam

Foreign (non UE) citizen students

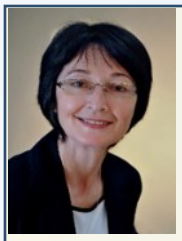
1. Enrolment/matriculation fee 150lei
2. Annual tuition fee 3200Euro (1600Euro/semester)
3. Re-examination 100Euro/exam

Teachers

Teachers from UMF "Iuliu Haţieganu"



Ioan TOMUȚĂ, PhD. Professor of Pharmaceutical Technology and Director of Pharmaceutical Industry master's program since 2016. He holds a diploma in Pharmacy and PhD in Pharmaceutical Technology. In the professional activity, he combined the didactic activity with scientific research and that of technical adviser. The main area of research is drug development following QbD approach and PAT implementation in pharmaceutical Industry. For more than 15 years he provides consultancy for Romanian pharmaceutical companies in the fields of pharmaceutical development/processes optimization and manufacture/research infrastructure development.



Marcela ACHIM, PhD. Professor of Pharmaceutical Technology, Faculty of Pharmacy, University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj -Napoca and primary pharmacist. With more than 25 years of experience in university education, she combined the didactic activity with that of scientific research, the main area of research being the micro and nanoparticulate systems for targeted therapy. She has a long collaboration in the master's program in pharmaceutical technology, the main topics being the knowledge of the raw materials and the fundamental aspects of quality assurance in the pharmaceutical industry.

Laurian VLASE, PhD. Professor of Biopharmacy and Pharmacokinetics with more than 15 years experience in organizing bioavailability studies, bioanalysis and pharmacokinetic analysis. His scientific activity in the field of biopharmacy-pharmacokinetics includes more than 200 articles published and 5 projects won by national competition. Over the last years, he had several training and consultancy projects with prominent Romanian pharmaceutical companies.

Radu OPREAN, PhD is full professor at the University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj-Napoca-Cluj, being the head of the Doctoral School of the same university since 2012. He has been teaching analytical chemistry for more than 25 years. His scientific portfolio includes separation techniques (e.g. GC, HPLC and electrophoresis hyphenated with MS), chemometrics and method validation for life sciences purposes (e.g. drug, food and environmental analysis).

Ede BODOKI, PhD is professor at the Analytical Chemistry Department. As a pharmacist by formation, he has more than 15 years of experience in (bio)analysis exploiting various separation, spectroscopic, electrochemical and hyphenated analytical techniques. He demonstrates good expertise in different chemometric tools indispensable in process optimization, analytical method development/validation and data analysis/ mining. Research in specific supramolecular interactions (nanostructured surfaces, molecularly imprinted polymers) were successfully applied in chiral analysis/sensing, drug-target interactions and drug delivery.

Brândușa TIPERCIUC, PhD is professor at the Department of Pharmaceutical Chemistry, University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj-Napoca. The scientific activity has as main directions the chemical development (synthesis, structural analysis) of some new heterocyclic molecules having an antimicrobial, anticancer, antiinflammatory or antioxidant potential. Other areas of expertise include the virtual design of new drugs, the study of qualitative and quantitative relationships between chemical structure, biological activity, retention parameters through the use of mathematical models (Free-Wilson, Hansch, PCA, MR).

Alina PORFIRE, PhD. Associate Professor in the Department of Pharmaceutical Technology and Biopharmaceutics, UMF "Iuliu Haţieganu", Cluj-Napoca. She attended Regulatory Affairs Professionals Society approved training courses on European Regulatory Procedures and Preparation of the CTD for Marketing Authorization application. She participated in research projects in collaboration with pharmaceutical industry, being responsible for the preparation of the Quality section of the CTD.

Elena DINTE, PhD. Associate professor at the Department of Pharmaceutical Technology and Biopharmaceutics, primary pharmacist. Emphasizes the correlation between drug formulation and benefits for pharmacotherapy, the main objectives of the research activity being the formulation, optimization and *in vitro – in vivo* characterization of the bioadhesive systems. She is involved in preparing students for the professional environment, being coordinator of the optional "Career Guidance" course.

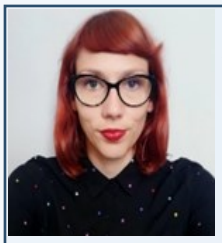
Smaranda ONIGA, PhD. Associate professor at the Department of Therapeutical Chemistry, Faculty of Pharmacy, University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj-Napoca. With over 20 years of experience in education, she combined the teaching activity with that of scientific research. Her research is focused on the synthesis and identification of lead compounds, their antibacterial, anti-inflammatory or antioxidant activity. The main synthetic interests are heterocyclic compounds containing the thiazol, oxazol or oxadiazol nuclei.

Andrei MOCAN, PhD. Associate Professor at the Department of Pharmaceutical Botany. A pharmacist by training, he combines research with teaching activities. His research interests comprise valorisation of traditional medicinal plants, extraction of bioactive compounds from plants, bioactivity and chemical characterization of natural products, development of new nutraceuticals based on medicinal plants. He has been involved in several research projects in the area of natural products and made several research stages in Germany, Portugal or Italy.

Teachers

Teachers from UMF "Iuliu Hatieganu"

Rareș IOVANOV, PhD. Lecturer at the Pharmaceutical Technology and Biopharmacy Department, Faculty of Pharmacy, University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj-Napoca. The main field of research: formulation, development, characterization and optimization of modified release monolithic or multi-particulate pharmaceutical preparations.



Cristina Ioana Stoica, PhD. Lecturer at the Therapeutical Chemistry Department and a specialised pharmacist in Pharmaceutical Laboratory. The research is focused on the synthesis and identification of lead compounds with antimicrobial activity. The main synthetic interests are heterocyclic compounds containing the thiazole, oxazole or oxadiazole rings.

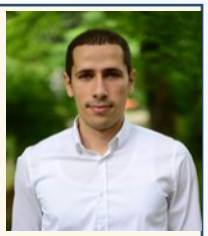
Bogdan-Cezar IACOB, PhD. Lecturer in Analytical Chemistry. His expertise covers the synthesis of artificial receptors based on molecular imprinting and various fields of instrumental analysis (HPLC, HPTLC, capillary electrophoresis, capillary electro-chromatography, electrochemical techniques, solid phase extraction, spectroscopy) with applications in the pharmaceutical, biomedical and environmental sample analysis.

Ioana-Andrada IONUȚ, PhD is currently lecturer at the Pharmaceutical Chemistry Department. Her research activity is focused on developing (design, synthesis, structural analysis) new heterocyclic compounds as potential antimicrobial, anticancer or antioxidant agents. Her research expertise also includes the determination of the lipophilic character of biologically active synthetic compounds, using Principal Component Analysis (PCA) based on RP-TLC data.

Sonia IURIAN, PhD is lecturer in the Department of Pharmaceutical Technology and Biopharmacy . She has been involved in teaching activities, in student laboratory sessions and postgraduate courses. She had several Industry collaborations, both for research and teaching purposes. Her research work focuses on applying the QbD principles and the development of new patient-friendly and paediatric dosage forms.

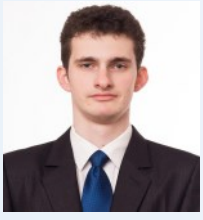
Dana HALES, PhD. Assistant professor in the Department of Pharmaceutical Technology and Biopharmacy, Faculty of Pharmacy, University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj-Napoca and specialist pharmacist (Pharmaceutical Laboratory, 2014). The main area of interest in her research activity is the development of conventional and modern targeted drug delivery systems. She is interested in intellectual property in the pharmaceutical field.

Lucia Tefas, PhD is a pharmacist working within the University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj-Napoca. She is currently lecturer for the Pharmaceutical Technology and Biopharmacy Department within the Faculty of Pharmacy, where she teaches laboratory activities for students. She holds a PhD from the University of Cluj-Napoca. Her research is related to nanotechnology, and is focused on developing nanoparticulate drug delivery systems, mainly for cancer therapy.



Tibor CASIAN, PhD. Assistant professor within the Department of Pharmaceutical Technology and Biopharmacy. Main area of research, interest and expertise is focused on the application of multivariate data analysis within the pharmaceutical development process: Quality by Design (QbD) based formulation and process development, implementation of PAT instruments, analysis of historical data, statistical process monitoring and control, discrimination and classification.

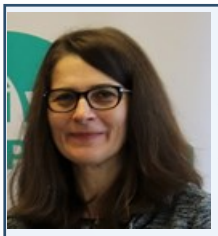
Alexandru GÂVAN, PhD. Assistant professor within the Department of Medical Devices, Faculty of Pharmacy, University of Medicine and Pharmacy "Iuliu Haţieganu", Cluj-Napoca. The main area of research is concentrated on the application of multivariate data analysis within the pharmaceutical development process, for the implementation of Process Analytical Technology (PAT) instruments and Quality by Design (QbD) based formulation and process development.



Gabriel MARC is a pharmacist working as assistant professor in the Department of Pharmaceutical Chemistry. The main area of interest in his research activity is the chemical synthesis and characterization of novel synthetic bioactive compounds. His research activity is complemented by modern *in silico* techniques such as molecular docking. A new research direction is to obtain and characterize compounds with antioxidant and antiradical activity, such as polyphenols.

Teachers

Associated Teachers



Silvia IMRE, PhD is Professor at the Department of Analytical Chemistry and Drug Analysis, University of Medicine, Pharmacy, Sciences and Technology "George Emil Palade" from Târgu Mureş, PhD in Drugs Control, senior pharmacist in Pharmaceutical Laboratory specialty. Her research topics include: profiling of drug impurities, stability studies of pharmaceutical substances and products, development and validation of bioanalytical LC methods, HPLC chiral separation of drugs.

Horaţiu MIRESAN, PhD. Primary pharmacist and chemical engineer. Associate Professor in Toxicology and Pharmacology at the Faculty of Pharmacy from Constanta. Over 15 years of experience in the pharmaceutical industry (4 years experience in the Research - Development - Regulatory Department and 12 years of experience in the Quality Control Department). Director of the Quality Control Department at Magistra C&C, Constanta.

Cristian ALECU, PhD. Specialist in pharmaceutical technology, project management and pharmaceutical management, with over 5 years experience in the pharmaceutical industry. PhD in Pharmaceutical Sciences and MBA graduate, is actively involved in the development of projects and products in the pharmaceutical field. Between 2008-2017 he was CEO at Laropharm, a Romanian pharmaceutical generic company located in Bucharest. Currently coordinate de manufacturing and development activity at Polisano Pharmaceuticals.

Trained as a pharmacist, with a PhD in drug analysis obtained in 2012, **Balázs SZANISZLÓ** is bringing with him a solid experience in quality assurance, quality control and pharmaceutical compliance. As a qualified person with focus on outsourced activities, he combines expertise in GxP, regulatory processes and global authority expectations for small molecule and biologic pharmaceuticals, medical devices and combination products. Science 2016 works in the filed of biologic pharmaceuticals at LEO Parma and Novo Nordisk

Camelia FLOREA, PhD, Manufacturing Plant Head, STADA Group, Turda, Romania. Specialist Pharmacist in Pharmaceutical Laboratory, PhD in Pharmaceutical Sciences from Iuliu Haţieganu University Cluj -Napoca, and MBA graduate at Durham University in UK. With more than 20 years experience in Pharmaceutical Industry, Dr Florea brings to the program her cross functional experience and real examples from pharmaceutical industry practice in both generic an innovative medicines production. Contributed to implementation of a strong Quality Management System, complying with requirements of worldwide healthcare authorities, in an environment with increasing expectations related with product quality, compliance systems, documentation and data integrity.

Eva Katalin KELEMEN, PhD Product Development Director, Gedeon Richter Romania SA. PhD in pharmaceutical sciences with almost 20 years' experience in generic drug development for the international markets in a local pharmaceutical company. Drug development is fuelled by the interest to launch new drugs as quickly as possible, at the lowest cost possible, balanced by the interest to achieve maximum product safety shared by the regulatory authorities and the drug industry. A comprehensive understanding of the formulation and regulatory process enables you to take a more strategic and tactic approach. This way, you can ensure innovation progress, maintain product safety, and obtain a speedy marketing authorization.

Adriana MARCOVICI, PhD has over 20 years experience in the pharmaceutical industry of generic drugs, especially in the field of clinical bioequivalence studies. At Terapia SA, *a Sun Pharma company*, Dr. Marcovici coordinates the activity of an experienced group of researchers, doctors, pharmacists, chemists and biologists, specialized in organizing, planning, executing bioequivalence studies, developing and validating bioanalytical methods, pharmacokinetic and statistical analysis

Adela Elena GIGEA, PhD is a licensed pharmacist (UMF Cluj) and holding a doctoral degree in the field of pharmaceutical technology. The professional career includes positions in different areas of the pharmaceutical industry including Bioequivalence Studies, Quality Assurance, Phase I Clinical Trials, Project Management and Medical Affairs. Adela is currently occupying the position of Medical Advisor Anti-infectives in Berlin, Germany and now is studying MBA at the University of Potsdam.

Content of the study program

1st semester

Drug Regulatory Affairs

Course lecture

1. Drug legislation and drug regulation. Principles of Regulatory Affairs. Regulatory Framework. Regulatory bodies, structure and responsibilities. Regulatory guidelines, national and international.
2. The role of regulatory affairs during drug development. Patent Terms and Patent Certification.
3. Registration dossier. Content. CTD format. General overview on the CTD structure. Administrative information in Module 1. Summary and overview in Module 2. Quality – Module 3.
4. Type of marketing authorization in EU. Full dossier. Generics. Biosimilars. Bibliographic application (well established use). Fixed dose combination. Regulatory data protection and market exclusivity.
5. Regulatory pathways to obtain the marketing authorization. Centralized procedure. Decentralised and Mutual recognition procedures. National procedure. Regulatory procedures for specific product types.
6. The role of regulation affairs after marketing authorization. Variation. Line extension. Renewals of marketing authorization.
7. Variation. European Variations Procedure. Introduction and legal background Classification of variations. Procedural handling of variations. How to document a Variations Procedure: documentation requirements for different types of variations, timelines, change control system.

Seminars

1. Filing the registration dossier. Modules 1 and 2.
2. Filing the registration dossier. Module 3.
3. Filing variation application type I.
4. Filing variation application type II.
5. Filing the dossier in eCTD format .

7 ECTS credits

Coordinator:

Assoc. Prof. Alina PORFIRE, PhD

– UMF "Iuliu Haţieganu" –

Collaborator:

Dr. Éva Katalin KELEMEN

– Gedeon Richter Romania , Product Development Director –

Objectives

1. To provide knowledge about national and EU regulatory framework on medicinal product authorization.
2. To teach how to prepare and submit a dossier for marketing authorization. To learn how to prepare and submit post-authorization documents: variations, line extensions, renewal of marketing authorization.

Ethics and Academic Integrity

Course lecture

1. The presentation of the course. Introduction. Definitions
2. Ethics and academic integrity principles
3. Legislation, national and international guidelines and codes regarding ethics and academic integrity principles
4. "Iuliu Haţieganu" University's Carta univesitaria, deontology and ethics codes
5. The responsibility for the failure to comply to the ethics and academic integrity principles
6. Case studies regarding the failure to comply to the ethics and academic integrity principles
7. Conclusions regarding the importance of the entire course for the master's students on ethics and academic integrity

4 ECTS credits

Coordinator:

Lecturer Rareș IOVANOV, PhD

– UMF "Iuliu Haţieganu" –

Objectives

1. Learning the ethics and academic integrity principles by the master's students.
2. Understanding the necessity / importance of the application and compliance to the ethics and academic integrity principles and identifying misconducts in relation to these principles.

Content of the study program

1st semester

PHARMACOKINETICS IN DRUG DEVELOPMENT AND EVALUATION

Conținut curs

1. Introduction to pharmacokinetics. The Importance of Pharmacokinetics. The study subject of Biopharmacy and Pharmacokinetics. Fundamental pharmacokinetics. The notion of pharmacokinetic compartment. Kinetic processes notions. First order kinetic process and zero order kinetic process in the human body.
2. Pharmacokinetic models. The one-compartment pharmacokinetic model. Single intravenous administration. Rate of elimination. Biological half-life. Volume of distribution.
3. Extravascular administration. Absorption rate constant. Data analysis from the site of absorption. Analysis of plasma data. Method of residuals for calculation of the absorption constant.
4. Intravenous infusion. Infusion rate. Steady-state concentration. Loading dose. End of perfusion.
5. Repeated intravenous and extravascular dose pharmacokinetics. Cmax, Cmin, Css, loading dose, dosing interval.
6. Pharmacokinetics of metabolites. Kinetic analysis models for one metabolite or several metabolites. The constant of metabolism and its calculation.
7. The two-compartment pharmacokinetic model. Other pharmacokinetic models. Pharmacokinetics of biological response.
8. Biological factors influencing the pharmacokinetics of drugs: body mass, age, gender, menstrual cycle, pregnancy, pharmacogenetics, chrono-pharmacokinetics.
9. Pathological factors influencing the pharmacokinetics of drugs: liver, kidney, heart, and bile impairment

Seminars

1. Pharmacokinetic analysis softwares: Phoenix WinNonlin, Kinetica. Software use. Predefined pharmacokinetic models. Custom pharmacokinetic models. Writing a custom pharmacokinetic model. Discrimination between competing models.
2. Single dose intravenous administration: analysis of plasma data. Preparing and structuring the data for analysis, choosing the pharmacokinetic model, choosing the starting values of the pharmacokinetic parameters, statistical analysis of the data, reporting the data.
3. Single dose extravascular administration. Data analysis from the site of absorption, analysis of plasma data. Preparing and structuring the data for the analysis, choosing the pharmacokinetic model, choosing the starting values of the pharmacokinetic parameters, statistical analysis of the data, reporting the data.
4. Rapid intravenous administration, two-compartment model: data analysis, comparison with the one-compartment model, statistical analysis, interpretation of the results.
5. Intravenous infusion, one- and two-compartment pharmacokinetic model: data analysis, pharmacokinetic model selection, statistical analysis, interpretation of results.
6. Repeated intravenous and extravascular dosing. The loading dose. Data analysis. Simulation of various situations: omission of a dose, concomitant administration of two doses.
7. Pharmacokinetics of metabolites. Writing a pharmacokinetic model for the simultaneous analysis of the drug substance and the metabolite. Data analysis and interpretation of results.
8. Factors influencing the pharmacokinetics of drugs, case study: pharmacokinetic analysis, statistical demonstration of the influence of three competing factors on pharmacokinetics.
9. Pharmacokinetic analysis of a drug interaction, case study.

7 ECTS credits

Coordinator:

Prof. Laurian VLASE, PhD
– UMF "Iuliu Haţieganu" –

Objectives

1. Presentation of the principles of pharmacokinetic analysis.

2. Understanding the basic principles of pharmacokinetic analysis by students.

3. Provide knowledge on the mathematical way of analysing the plasma profile of a drug in order to obtain pharmacokinetic parameters.

4. Providing knowledge related to the use of softwares for pharmacokinetic analysis.

Content of the study program

1st semester

EXPERIMENTAL RESEARCH METHODOLOGY

7 ECTS credits

Coordinator:

Lecturer Sonia IURIAN, PhD

– UMF "Iuliu Haţieganu" –

Course lecture

1. *Introduction to experimental research methodology.* The importance of research in the pharmaceutical industry. Research rationale and motivation. Defining research objectives. Research Types/Approaches. Guidelines on good research practices. Ethical principles of scientific research. Defining a problem in the pharmaceutical industry. Guidelines in performing a bibliographic study. Information sources. Using on-line scientific databases. Examples.
2. *Risk analysis*. Risk analysis within the concept of Quality by Design. ICHQ9 - Risk Management. Risk Management - Stages. Methods and elements of risk management. Failure Modes and Effects Analysis (FMEA). Tree diagrams for error analysis. Ishikawa diagrams (fish bone). Hazard and critical parameters analysis. Filtering and classification of risk sources. Developing an Ishikawa diagram. Example of FMEA analysis resulting in a series of critical parameters / independent variables.
3. *The concept of design of experiments*. Experimental Process and the design of experiments. Strategies for the research of a phenomenon: empirical method, design of experiments method. When and How to Use Design of Experiments? Defining the variables in a design of experiments. Independent variables (factors). Quantitative factors. Qualitative factors. Dependent variables (responses). Selection of independent and dependent variables. The matrix of the design of experiments. Response matrix.
4. *Design of experiments development*. Problem formulation, selection of objectives, factors and responses. Full Factorial designs. Construction of full factorial two-level experimental designs 2^k: 2^2 two factors and two levels; 2^3 three factors and two levels. Construction of full factorial experimental designs with three levels 3^k: 3^2 two factors and three levels; 3^3 three factors and three levels. Fractional (reduced) factorial designs. Construction of fractional experimental designs with two levels 2^{k-p}: 2^{3-1} three factors and two levels; 2^{5-2} five factors and two levels. Construction of fractional orthogonal experimental designs: Plackett - Burman, Box-Behnken, Taguchi, Central Composite, Doehlert, D-optimal.
5. *Design of experiments analysis*. Primary evaluation of raw experimental data. Determination of the exponential equation, regression analysis: MLR (multiple linear regression), PLS (partial least squares). Statistical analysis of parameters of the model equations: histograms, ANOVA, residuals, R2, Q2. Analysis of exponential equation coefficients: the constant term, first order terms, the second order term, the terms produced. Analysis of response curves. Surface response analysis.
6. *Optimization methods*. Optimization using model-dependent methods: overlapping the response curves; by the "constraint" coefficient. Optimization using independent (sequential) model methods: simplex, modified simplex, multi-simplex.
7. *What is QbD and why is it necessary*? Designing structures for identifying functional interrelations, using interrelations vs SOP, design space development; QTPP, CQA, CPP, parameter classification, process and facility qualification within design space. Practical application of the Design Space concept.
8. Experimental results and analysis – structure and presentation. Dissemination methods. The concept of confidentiality and intellectual property. Poster or PowerPoint presentation of the results. Writing a scientific paper.

Seminar

1. Application that aims to search for a practical problem in the pharmaceutical industry and turn it into a scientific research objective. Bibliographic study on the chosen subject. (search ScienceDirect, Google Scholar, PubMed data bases).
2. Practical application of risk analysis. Study of the factors that influence the system. Establishing the Critical Parameters. How to develop an Ishikawa diagram. FMEA analysis. Using the results of risk analysis in developing an experimental design.
3. Familiarization with the experimental design program (eg Modde, Sartorius, Sweden, R +, Unscramble, Camo, Norway, Design Expert etc.). Example of development, analysis and interpretation of the simplest simple type of experimental design: the two-factor and two-level experimental design 22 using a dedicated computer program (Modde, Sartorius, Sweden).
4. Hypothesis statement, defining factors and responses to develop a design of experiments meant to solve a particular problem. Defining Factors, Responses, and Experimental Design Matrix. Analysis of DoE. Statistical analysis of experimental data: histograms, ANOVA test, residuals, R2, Q2, determination of the exponential equation using dedicated computer programs. Interpretation of DoEs. Analysis of coefficients of exponential equations: the constant term, the first order terms, the second order term, the interaction terms, the analysis of the response surfaces using dedicated computer programs.
5. Data analysis from a study that aims at the optimization of a pediatric use oral lyophilizate formulation with loratadine. Stage 1 – screening. Stage 2 – optimization, using Modde software.
6. Data analysis from a study that aims at the optimization of a fluid bed granulation process of two APIs. D-Optimal experimental design.
7. How to make a poster/ppt presentation or a project report based on a DoE.

Objectives

1. Acquiring the principles that support rational, scientific experimental research and correct interpretation of data obtained from experimental research.
2. Understanding of the principles underlying ethical research Acquiring the principles underpinning the rational organization of experimental research so as to obtain the maximum of information following a minimum number of experimental determinations.
3. Being aware of the benefits of using design of experiments in experimental research work.
4. Acquiring knowledge related to the construction, analysis and interpretation of a design of experiments.
5. Gaining knowledge on the use of statistics in experimental data analysis and interpretation.
6. Gaining knowledge on the correct interpretation of data obtained from experimental research.

Content of the study program

1st semester

Optional courses - the students must follow one of them (5 ECTS credits)

Medicinal Chemistry*

Course lecture

1. Basic concepts in medicinal chemistry and targets of drug action (receptors, nucleic acids, enzymes). Concepts of Drug Design and Development.
2. Basic concepts, content, format and interpretation of ASMF (Active Substance Master File) or CEP (European Pharmacopoeia Suitability Certificate).
3. Chemistry and action of antibacterial, antiviral, antifungal and antiparasitic drugs.
4. Chemistry and action of anticancer drugs.
5. Chemistry and action of drugs used in gastrointestinal and respiratory disorders.
6. Chemistry and action of drugs used in cardiovascular disease.
7. Chemistry and action of drugs used in the treatment of pain.
8. Chemistry and action of drugs used in metabolic syndrome.
9. Chemistry and action of drugs used in psychiatric and neurological disorders.

Laboratory activities

1. Presentation of the main objectives and activities. Content knowledge and understanding the steps of the CEP / ASMF procedure.
2. Synthesis of a drug substance: material control, control of the critical and intermediate steps.
3. Synthesis of a drug substance: Validation and influence of reaction conditions on the yield and on the impurity profile.
4. Purification. Control of impurities and active substances obtained by chemical synthesis.
5. Packing of the active substance and the influence of environmental conditions on the stability.

**** Course recommended for students with bachelor studies in medicine, biology, chemistry, physic, engineering, mathematics, etc.***

Coordinator:
Assoc. Prof. Smaranda ONIGA, PhD
– UMF "Iuliu Haţieganu" –

Collaborator:
Asst. prof. Cristina STOICA, PhD
– UMF "Iuliu Haţieganu" –

Objectives

1. Acquiring some basic notions about the importance of the chemical structure in terms of interaction with the molecular targets.
2. Acquiring basic knowledge of pharmacodynamics.
3. To acquire the scientific principles underlying the design and manufacture of a medicinal product.
4. To acquire knowledge about specific regulations in the field of development and manufacturing of an industrial medicinal product.

Design, Discovery And Synthesis Of Medicinal Drugs**

Conţinut curs

1. Discovery of new medicinal drugs: evolution, definitions and objectives. Choosing a pathology, choosing a target, structural, functional and biochemical characterization of drug targets, validation of the drug target. Ligands of drug targets: properties and characterization.
2. Identification of "hit" and "lead" compounds. Strategies, screening methods: HTS, knowledge based screening, fragment screen, virtual screening, physiological screening
3. Leaders (serie "head" molecules). Sources for identification, features, "head" optimization. Modification of the molecular interactions with the substrate, bio-isosters obtention.
4. Optimization of pharmacokinetic properties. Prodrugs and analogues.
5. QSAR 2D and 3D models.
6. Computer based new drugs' design. Molecular docking studies. Molecular similarity. Affinity prediction. Pharmacokinetic and pharmacotoxicological properties' (ADME-Tox) predictions.
7. Synthetic methods for prodrugs and analogues. Functional groups protection and activation methods. Bio-isosters synthesis
8. Stereochemistry and its role in drug synthesis. Synthesis of peptides and peptidomimetics. Synthesis of immunoconjugates. Modern methods of chemical synthesis (flow-chemistry, combinatorial chemistry).

Laboratory activities

1. Drug design. Practical approach to virtual screening.
2. Applications of QSAR methods (Hansch, Free-Wilson, Combined Method) on literature compounds.
3. ADME-Tox virtual study. Practical application
4. Synthesis and structural analysis of a synthetic compound with azole structure

***** Course recommended for students with bachelor studies in pharmacy***

Coordinator:
Prof. dr. Brîndușa TIPERCIUC, PhD
– UMF "Iuliu Haţieganu" –

Collaborators:
Lecturer Ioana IONUŢ, PhD
Asst. prof. Gabriel MARC
– UMF "Iuliu Haţieganu" –

Objectives

1. Acquisition by master students of the methods used in the identification of "hit" compounds and specific targets;
2. Acquisition by all master students of the evolutionary methodology from "hit" to "lead" and "candidate molecule" for preclinical and clinical studies;
3. Acquisition by all master students of the modern principles of chemical synthesis (including in the microwave field) of new biologically active substances

Content of the study program

2nd semester

Analytical Drug Development

Course lecture

1. Analytical Drug Development

Important documents and guidelines in analytical development. Early documentation. Risk Analysis. CTD requirements. GMP/GLP requirements.

Fundamentals of analytical determinations.

From fundamental chemical properties to analytical properties. Analytical properties: main, basic, secondary, correlations between properties. Instrumental design.

2. An overview of analytical specificity/selectivity.

Detection, separation, computational selectivities. Strategies regarding sample preparation - extraction methods with high selectivity; automatic sample preparation; particular aspects regarding sample preparation in pharmaceutical analysis and medical bioanalysis.

Quantification and quality of analytical data.

Analytical measurement. Variability in analytical measurement. Errors. Accuracy and precision. Analytical problem and the quality of measurements. Noise. Limit of detection. Limit of quantification. Qualitative analysis. Quantitative analysis (single analyte analysis; algorithms in factorial analysis – PCR and PLS methods). Measurement uncertainty in analytical determinations: measurement uncertainty, propagation of errors, detection and quantitation limits, noise & drift, statistical aspects, Data Integrity quality in analytical laboratory.

3. Development and validation of analytical methods in pharmaceutical analysis.

From method development to method validation. Implementation of QbD in development of an analytical method. Life cycle of an analytical method. Validation of analytical methods applied in drug analysis. Terminology. ICH, FDA and EMA guidelines.

Statistical Aspects of Analytical Methods Validation. Basic theory of the common statistical techniques. Merits, pitfalls and underlying assumptions of particular tests. The meaning behind. Standard deviation - F-test - t-test. ANOVA - Correlation Coefficient. Linear regression. Exploration of more sophisticated statistical techniques such as interval hypothesis testing and experimental design

4. Chromatographic and electrophoretic techniques applied in drug analysis.

Thin-layer chromatography, high-performance thin-layer chromatography, high-performance liquid chromatography, gas chromatography, hyphenated techniques. Capillary electrophoresis and related techniques. Chiral analysis. Fundamentals and practical aspects.

6. Mass spectrometry in drug analysis.

Fundamentals and practical aspects.

5. Emission spectrometry and diffraction in drug analysis.

Fluorescence spectrometry. Raman spectrometry. Atomic absorption and emission spectrometry. X-Ray diffraction. Fundamentals and practical aspects..

Laboratory activities

1. Experimental development strategies are presented, discussed and illustrated with some practical examples. HPLC / GC / spectroscopic methods
2. Experimental validation strategies are presented, discussed and illustrated with some practical examples.
3. The statistical tests used in method validation are presented and discussed on practical examples.
4. GLP requirements in analytical development within an industrial environment are illustrated together with the worldwide procedures for quality targeted management

6 ECTS credits

Coordinator:

Prof. Radu OPREAN, PhD

– UMF "Iuliu Haţieganu" –

Collaborators:

Prof. Ede BODOKI, PhD

Lecturer Bogdan Cezar IACOB, PhD

– UMF "Iuliu Haţieganu" –

Prof. Silva IMRE, PhD

– UMFST "George Emil Palade" Târgu Mureş –

Assoc. prof. Horaţiu MIREŞAN, PhD

– Magistra C&C Romania , Quality Control Director –

Objectives

1. To know the principles of developing and optimizing the analytical procedure for drug analysis.
2. To acquire up-to date scientific and practical knowledge in the selection and use of advanced instrumental techniques, data processing and statistical tools employed in drug analysis.
3. To acquire in-depth knowledge related to analytical methodologies employed in the process of pharmaceutical development.
4. To acquire knowledge about specific regulations related to drug analysis in the pharmaceutical

Content of the study program

2nd semester

PHARMACEUTICAL DRUG DEVELOPMENT

7 ECTS credits

Course lecture

1. Generations of drugs and designing new drugs.

Formulation of drugs and development of the manufacturing process (pharmaceutical development). Formulation and process parameters in drug development. The provisions of ICH Q8 guideline - Pharmaceutical development. Legislative requirements regarding the pharmaceutical development of drugs.

2. Preformulation of drugs.

The evaluation of physical, chemical, biological and pharmaceutical properties of active substances: particle shape and size, polymorphs, stability, solubility and dissolution rate, methods for solubility, permeability and bioavailability increase. The evaluation of the physical, chemical and pharmaceutical properties of excipients. The drug-excipient compatibility.

3. The Quality by Design (QbD) concept.

An overview of the QbD approach in pharmaceutical industry. The parts of QbD according to ICH Q8, 9, 10 and 11 guidelines. The basic principles of QbD. Overview steps of the QbD concept in the work flow. Working tools used to select the steps and the matrices used at each stage of manufacturing within a QbD approach.

4. Key concepts in QbD.

Quality Target Product Profile (QTPP), Critical Quality Attributes (CQAs) and Critical Process parameters (CPPs). The role of material attributes in the QbD approach. Defining the Design Space. The control strategy. Life Cycle Management of a drug product. QbD in the life cycle management of a drug product: from pharmaceutical development to technological process validation and continuous process verification. The Design Space: from laboratory scale pharmaceutical development to industrial scale process validation.

5. Process Analytical Technology (PAT).

How to use PAT during pharmaceutical development. The definition of PAT and its' link to QbD. PAT tools: on-line/in-line/at-line sensors, experimental design, multivariate data analysis, process control, accumulated knowledge management and continuous improvement. The adequate selection of sensors. Analyzing and monitoring the Quality Target Product Profile (QTPP). Management of multivariate inputs.

6. Drug release from pharmaceutical products.

The concept of drug release: what, how, where, when, why? The influence of the physico-chemical properties of active substance/excipients on drug release. Including the kinetics of drug release in the Quality Target Product Profile. Problems in drug release from pharmaceutocal products. The biopharmaceutical classification systems as tools for the selection of pharmaceutical dosage form and active substance. In vitro and in vivo models to support the drug development process.

7. An overview of scale-up. The objectives. Adimensional analysis - general features. Scale-up from laboratory series to pilot / industrial series and development of technological process. Examples of scale-up for pulverization, homogenization / mixing, granulation, compression, coating, drying, lyophilization.

Laboratory activities

1. Drug development by the QbD approach. Establishing the QTPP and the CQAs of the product. Establish the Design of experiments (DoE), to link the CMAs/CPPS to CQAs.
2. Preparation and pharmaco-technical analysis of formulations according to DoE (4-5 formulations/session).
3. Data analysis and interpretation of experimental results. Design Space determination. Design Space validation.

Coordinator:

Prof. Ioan TOMUȚĂ, PhD

– UMF "Iuliu Haţieganu" –

Collaborators:

Lecturer Rareș IOVANOV, PhD

Asst. prof. Alexandru GÂVAN, PhD

– UMF "Iuliu Haţieganu" –

Éva Katalin KELEMEN, PhD

– Gedeon Richter Romania , Product Development Director –

Objectives

1. To know the principles of developing the manufacturing technology for a drug product.
2. To acquire the scientific principles underlying the conception, design, manufacture and authorization of a drug product.
3. To acquire in-depth knowledge on pharmaceutical development (formulation, development of the technological process) of industrial drug.
4. To acquire in-depth knowledge of the quality of industrial drug products.
5. To acquire knowledge about specific regulations in the field of drug development and drug manufacturing in pharmaceutical industry .

Content of the study program

2nd semester

Drug Bioavailability and Bioequivalence

5 ECTS credits

Course lecture

1. Introduction to Biopharmacy. Methods of biopharmaceutical quality assessment of drugs, in vitro dissolution test: in vitro dissolution conditions. Biorelevant dissolution media.
2. Methods of biopharmaceutical quality assessment of drugs, clinical trial (in vivo): absolute and relative bioavailability. Design of clinical studies to determine bioavailability.
3. Non-compartmental pharmacokinetic analysis.
4. Influence of drug formulation on biopharmaceutical quality. Factors related to active drug substance, excipients or technological factors.
5. The Biopharmaceutic Classification System (BCS) of drugs. Usage, classes, applications.
6. Bioequivalence of drugs. Bioequivalence standards (Romania, European Union, United States of America). Preparing a bioequivalence study. Study protocol.
7. Analysis of the results of a bioequivalence study. Pharmacokinetic analysis and ANOVA statistics, sequence and period effect.
8. Special cases where bioequivalence is not mandatory. Exemption from bioequivalence study – biowaiver.
9. Documentation related to a bioequivalence study. Final report.

Seminar / laboratory activities

1. Methods of comparison of in vitro dissolution profiles, practical application and data analysis using the computer.
2. Non-compartmental pharmacokinetic analysis, practical application and data analysis using the computer.
3. Determination of absolute and relative bioavailability of drugs.
4. Determination of bioequivalence of drugs (analysis of the actual data of two bioequivalence studies), specialized software use (Phoenix, Kinetica).

Coordinator:
Prof. Laurian VLASE, PhD
– UMF "Iuliu Haţieganu" –

Collaborators:

Adriana MARCOVICI, PhD
– Terapia, Romania, Pharmacology Clinical Pharmacokinetics Departament Manager –

Adela Elena GIGEA, PhD
– RIEMSER Pharma , Germany, Medical Affairs Manager –

Objectives

1. Presentation of the principles of biopharmaceutical analysis
2. Understanding the basic principles of biopharmaceutical analysis by students
3. Providing knowledge related to the use of software for biopharmaceutical analysis.

Industrial Drug Manufacturing I (raw materials)

7 ECTS credits

Course lecture

1. From drug substance to medicine. Industrial medicine versus compounded pharmaceutical preparation. General information about pre-formulation, formulation, optimization of formulation and process of manufacturing. The quality of the industrial medicine and the critical quality attributes.

2. Drug substances. Classification. Methods of obtaining, purification and critical quality attributes. Quality assurance in the drug substances production. Inorganic drug substances. Organic drug substances obtained by extraction. Organic synthetic drug substances. Drug substances obtained by pharmaceutical biotechnology.

3. Classic pharmaceutical excipients. Water quality in the pharmaceutical industry. Obtaining purified water. Excipients: carbohydrates, polysaccharides, proteins, minerals, hydrocarbons, waxes, triglycerides.

Functional excipients for injectable, ophthalmic, nasal, auricular, cutaneous, rectal and solid oral medications. Excipients to ensure organoleptic characteristics: sweeteners, flavorings, dyes, preservatives, antioxidants.

4. Modern pharmaceutical excipients. Polymeric excipients that influence drug release characteristics.

5. Packaging and packaging materials.

Laboratory activities

1. Drug development by the QbD approach. Establishing the QTPP and the CQAs of the product. Establish a base formulation, manufacturing process and a design of experiment (DoE) in order to study the influence of type and the ratio of 2-4 functional excipients on pharmaceutical properties of immediate/extended release oral dosage form.
2. Preparation and pharmaceutical analysis of formulations according to DoE (4-5 formulations/ session).
3. Data analysis and interpretation of experimental results. Comments the influence of type and rations of functional excipients on the pharmaceutical characteristics of dosage forms.

Coordinator:
Prof. Marcela ACHIM, PhD
– UMF "Iuliu Haţieganu" –

Collaborators:

Assoc. Prof. Elena DINTE, PhD
Lecturer Rareş IOVANOV, PhD
Asst. prof. Alexandru GÂVAN, PhD
– UMF "Iuliu Haţieganu" –

Objectives

1. To know the raw materials, the manufacturing conditions and the technologies used in industrial drug manufacturing.
2. To know the main characteristics that raw materials used in the manufacture of medicines must meet.
3. To acquire in-depth knowledge of the characteristics of active substances, excipients, packaging materials used in the fabrication of the industrial medicine.

Content of the study program

2nd semester

Optional courses - the students must follow one of them (5 ECTS credits)

PHARMACEUTICAL TECHNOLOGY I (PHARMACEUTICAL OPERATIONS AND TECHNOLOGIES)*

Course lecture

1. Pharmaceutical technology: Introduction. The objectives of the course. Pharmaceutical operations used during drug manufacturing. The sequence of operations in a manufacturing flow and its monitoring.
2. Filtration in pharmaceutical industry. The objectives. Types of filters used. Filtering technologies.
3. Drying in pharmaceutical industry. The theoretical framework. The equipment and technologies for solids drying. The equipment and technologies for drying solutions and suspensions.
4. Mixing in pharmaceutical industry. The objectives. Mixing of liquids. Mixing of semisolids. Mixing of powders.
5. Pulverization. The theoretical framework. Equipments for size reducing, pulverization, micronization.
6. Granulation. The objectives. The equipment and technologies for granulation.
7. Particle size analysis. Methods for particle size analysis. Expression of particle size and particle size distribution.
8. Compression. The objectives. The equipment and technologies for compression.
9. Coating of tablets and granules. The objectives. The equipment and technologies for coating.
10. Filling soft and hard gelatine capsules: the equipment and technologies used.
11. Sterilization. The objectives. The equipment and technologies for sterilization.
12. Extraction of bioactive compounds. The equipment and technologies for extraction.
13. Packaging of medicinal products. The objectives. The equipment and technologies used for liquids, semisolids and solids.

Laboratory activities

1. Pharmaceutical operations and technologies used in industrial manufacturing of drugs. Practical application for immediate release oral dosage forms.
2. Monitoring various operations during pharmaceutical manufacturing by the use of conventional and in-line tools. Practical application for immediate release oral dosage forms.
3. Pharmaceutical operations and technologies used in industrial manufacturing of drugs. Practical application for modified release oral dosage forms/pharmaceutical drug delivery systems (liposomes, polymeric nanoparticles, polymeric microparticles and microcapsules).
4. Monitoring various operations during pharmaceutical manufacturing by the use of conventional and in-line tools. Practical application for modified release oral dosage forms/ pharmaceutical drug delivery systems (liposomes, polymeric nanoparticles, polymeric microparticles and microcapsules).

**** Course recommended for students with bachelor studies in medicine, biology, chemistry, physic, engineering, mathematics, etc.***

Coordinator:

Assoc. Prof. Alina PORFIRE, PhD

– UMF "Iuliu Haţieganu" –

Collaborators:

Prof. Marcela ACHIM, PHD

Asst. prof. Alexandru GÂVAN, PhD

– UMF "Iuliu Haţieganu" –

Objectives

1. To know the operations and technologies used in the pharmaceutical industry.
2. To know the principles underlying the industrial manufacture of drugs, depending on the pharmaceutical dosage form.
3. To acquire knowledge about the operations involved in the industrial manufacture of drugs.
4. To know the equipment used for various operations in the pharmaceutical industry and their operation principles

Content of the study program

2nd semester

Optional courses - the students must follow one of them (5 ECTS credits)

BIOPHARMACEUTICAL DRUG MANUFACTURING**

Course lecture

1. Biopharmaceutical drugs. Definition. Biopharmaceutical market. Classification. Characteristics and advantages. Biopharmaceutical active ingredients obtained from natural sources and through genetic engineering. Applications of biopharmaceutical drugs

2. Biopharmaceutical drug pre-formulation and formulation. Stability of active biopharmaceutical ingredients and degradation pathways. Selection of the pharmaceutical form and administration route. Selection of excipients

3. Biopharmaceutical drug manufacturing. Facilities and equipment. Characterization and quality control of biopharmaceuticals. Manufacturing process validation. Biopharmaceutical drug stability evaluation. GMP requirements for biopharmaceutical products manufacturing

4. Approval of biopharmaceuticals. Legislative considerations and regulations. Safety and immunogenicity of biopharmaceuticals in preclinical studies

5. Biosimilar drugs. Legislative and regulatory requirements. Validation of biosimilars in preclinical and clinical studies. Comparability studies

6. Biopharmaceutical and biosimilar drug products. Clinical applications

Laboratory activities

1. Develop a nanoparticulate delivery system entrapping a biopharmaceutical drug according to the Quality by Design approach. Establish the Quality Target Product Profile and Critical Quality Attributes. Generate the experimental design which allows to identify relations between Critical Material Attributes/Critical Process Parameters and the Critical Quality Attributes of the drug product

2. Prepare and analyse formulations according to the experimental design. Perform 2-3 formulations/session

3. Analysis and interpretation of the experimental data

***** Course recommended for students with bachelor studies in pharmacy***

Coordinator:

Lecturer Lucia TEFAS, PhD

– UMF "Iuliu Haţieganu" –

Collaborators:

Assoc. Prof. Alina PORFIRE, PhD

– UMF "Iuliu Haţieganu" –

Balázs SZANISZLÓ, PhD

– Novo Nordisk, Denmark –

Objectives

1. Introduce the basic concepts of developing and manufacturing biopharmaceutical drugs, and the technology used to manufacture biopharmaceuticals.

2. Learn the main characteristics of the raw materials (active principles, excipients) and packaging materials used to manufacture biopharmaceutical drugs.

3. Learn the principles of biopharmaceutical drug manufacturing at industrial scale.

4. In-depth study on the formulation, manufacturing and quality of biopharmaceuticals.

5. In-depth study on the technologies used in the manufacturing of biopharmaceuticals at industrial scale.

6. Introduce specific regulations in the development, manufacturing and approval of biopharmaceutical drugs.

Content of the study program

3rd semester

INDUSTRIAL DRUG MANUFACTURING II (FACILITY AND MANUFACTURING PROCESS DESIGN)

Course lecture

1. Industrial drugs manufacturing. Manufacturing management. Operational documents. Scale up in pharmaceutical industry, laboratory-pivotal-industrial scales and technological transfer to other manufacturing sites: technological, legislative and quality assurance issues. Validation of technological manufacturing processes. Basic principles and objectives. Validation protocol. Statistical analysis of experimental data and writing validation report. Modern drugs manufacturing methods: serial production vs. continuous process manufacturing. Manufacture of drugs according to Quality by Design (QbD) and Process Analytical Technology (PAT). Moving from Process Validation to Continuous Process Verification.
2 GMP – compliant utilities and facilities design. GMP zone concepts (sterile/non-sterile/highly potent). GMP cleanrooms classification and ISO standards and their interaction. GMP requirements for cleanrooms floors, ceilings and walls. Personal and material flows. Access control. HVAC system concepts and air filtration and circulation (volumes, differential pressure, velocity, cleanliness, etc.). Product/ personal protection concepts and barrier/isolator systems. Avoiding cross-contamination. Other impact/ critical utilities systems (purified water, compressed air., etc). Particle and microbiological monitoring in cleanrooms. Qualification and requalification of cleanrooms and critical utilities systems.
3. GMP-compliant equipment design. Open vs. closed systems Materials and surfaces, roughness and structure of cleanable surfaces. Basic requirements for materials and pharmaceuticals handling. Risk analysis to identify the equipments, apparatus and utilities that has to be qualified. Defining user requirement specification (URS) for equipments, apparatus and utilities. Qualification, requalification and commissioning of equipments and apparatus. Definition maintenance/calibration system (frequencies, activities, tolerances, acceptance criteria, etc.) equipments and apparatus.
4. Industrial manufacturing of solid oral dosage forms. Regulations for oral dosage forms manufacturing. Facilities and equipments. Cleanrooms, contamination sources/ cross contamination and risk considerations. Manufacturing process design: steps, critical process parameters, critical quality attributes of solid oral dosage forms. Key pharmaceutical operations: dispersing and weighing, grinding, homogenization, granulation, compression, coating, packaging (primary and secondary).
5. Industrial manufacturing of parenteral drugs (injectable and infusible). Regulations for sterile manufacturing. Specific requirements regarding aseptic processing. Sterile manufacturing facilities conception and design. Cleanrooms, barrier systems, contamination sources and risk considerations. Decontamination cleaning and disinfection. Environmental monitoring and validation aspects. Equipments. Manufacturing process design: steps, critical process parameters, critical quality attributes of sterile dosage forms. Key pharmaceutical operations: dispersing and weighing, dissolution, filtration, dispersing/primary packaging, sterilization, secondary packaging.
6. Industrial manufacturing of ophthalmic and auricular preparations. Regulations for ophthalmic and auricular preparations manufacturing. Facilities and equipments. Cleanrooms, contamination sources/ cross contamination and risk considerations. Manufacturing process design: steps, critical process parameters, critical quality attributes of ophthalmic and auricular drugs. Key pharmaceutical operations: dispersing and weighing, dissolution, filtration, dispersing/primary packaging, sterilization, secondary packaging.
7. Industrial manufacturing of medicines for external use (solutions, gels, ointments, creams). Regulations for medicines for external use manufacturing. Facilities and equipments. Cleanrooms, contamination sources/cross contamination and risk considerations. Manufacturing process design: steps, critical process parameters, critical quality attributes of medicines for external use. Key pharmaceutical operations: dispersing and weighing, dissolution, filtration, emulsification, suspension, dispersing/ primary /secondary packaging.
8. Industrial manufacturing of rectal and vaginal drugs. Regulations for rectal and vaginal drugs manufacturing. Facilities and equipments. Cleanrooms, contamination sources/ cross contamination and risk considerations. Manufacturing process design: steps, critical process parameters, critical quality attributes of rectal and vaginal drugs. Key pharmaceutical operations: dispersing and weighing, dissolution, filtration, emulsification, suspension, dispersing/primary packaging, secondary packaging.
9. Industrial manufacturing of modern drugs (liposomes, micro/nano-particles, micro/nano-capsules). Regulations for modern drugs manufacturing. Facilities and equipments. Cleanrooms, contamination sources/ cross contamination and risk considerations. Manufacturing process design: steps, critical process parameters, critical quality attributes of modern drugs. Key pharmaceutical operations.

Laboratory activities

1. Formulation and design of a technological process for the industrial manufacture of classical drugs (i.e. oral preparations with immediate release)
2. Drugs preparation, process control and pharmaceutical analysis of the finished product using classical and modern (in-line) methods - classical drugs (i.e. oral preparations with immediate release)
3. Formulation and design of a technological process for the industrial manufacture of modern drugs (i.e. modified release matrix/reservoir type oral formulation; liposomal/micro/nano polymeric particles, micro/nano-capsules).
4. Drugs preparation and process control and pharmaco-technical analysis of the finished product using classical and modern (in-line) methods - modern drugs (i.e. modified release matrix/reservoir type oral formulation; liposomal/micro/nano polymeric particles, micro/nano-capsules).

7 ECTS credits

Coordinator:

Prof. Ioan TOMUȚĂ, PhD

– UMF "Iuliu Haţieganu" –

Collaborators:

Prof. Marcela ACHIM, PhD

Assoc. Prof. Elena DINTE, PhD

Lecturer Rareș IOVANOV, PhD

Asst. prof. Alexandru GÂVAN, PhD

– UMF "Iuliu Haţieganu" –

Cristian ALECU, PhD

– Polisano Pharmaceuticals Romania –

Objectives

1. Presentation of manufacturing conditions and technologies used in the manufacture of industrial drugs.
2. To acquire the scientific principles underlying the conception, design, manufacture of drug products.
3. To acquire in-depth knowledge of the quality of industrial drug products.
4. To acquire in-depth knowledge about specific regulations in the field of drug manufacturing in pharmaceutical industry.
5. To acquire in-depth knowledge on pharmaceutical manufacturing at industrial scale (process design, product development, scale-up, technological transfer, process validation).
6. To acquire knowledge on facilities design (characteristic and performance) used in industrial drugs manufacturing

Content of the study program

3rd semester

QUALITY ASSURANCE AND GOOD MANUFACTURING PRACTICE

7 ECTS credits

Coordinator:

Prof. Marcela ACHIM, PhD

– UMF "Iuliu Haţieganu" –

Collaborators:

Prof. Ioan TOMUȚĂ, PhD

– UMF "Iuliu Haţieganu" –

Camelia FLOREA, PhD

– STADA Romania, Manufacturing Site Head –

Course lecture

1. *Quality Assurance System and Good Manufacturing Practice (GMP)*. Brief history, key elements and responsibilities. Pharmaceutical Quality System, characteristics according to ICH Q10 key elements from ICH Q10. ICH Q10 compared to ISO 9001. Continual improvement. Process monitoring. Change management. Quality process performance and Quality Monitoring System.

2. *Basic Requirements of GMP for Medicinal Products*. Personnel, premises and equipment, production, quality control, outsourced activities, complaints and product recall, self inspection.

3. *Basic Requirements of GMP for Active Substances used as Starting Materials*. Types of active drug substances. Chemical-pharmaceutical documentation for active substances, requirements in EU, USA: module 3 CTD (Common Technical Document), CEP (Certificate of suitability of Monographs of the European Pharmacopoeia), ASMF (Active Substance Master File). Active substance - specifications and specification justification; official tests and acceptance criteria.

4. *Basic Requirements of GMP for Investigational Medicinal Products*.

5. *Documentation* as essential part of the Quality Assurance System

6. *Quality Risk Management (ICH Q9)*. Basic Requirements. Principles of risk management. Comparison with ISO 14971. Quality Risk Management in a GMP factory. Application of Quality Risk Management in the validation process. Practical examples.

7. *Change Control*. General requirements. Importance of Change Control. GMP requirements and change control according to GMP. Change documentation. Risk Management in Change Control. Risk Assessment in Change Control. Change implementation. Change Control across the product lifecycle.

8. *Qualified Person (QP) and Batch Certification*. QP in Quality System. Legal and professional duties and responsibilities of the QP. Evaluation of documentation and results, product quality assessment, batch disposition. Batch certification and release by the QP. QP roles and responsibilities in: audits, complaints, adverse events, change control, suppliers auditing and validation, etc. Delegation of tasks and responsibilities by the QP.

9. *Deviations*. International rules and regulations, EMA, FDA. Classification: critical, major, minor. Deviations handling. How to document corrective and preventive actions. Information and data management. Trends, product review and product quality review.

10. *Auditing and suppliers validating* as part of the Quality System. Who needs to be audited? Development of an audit program based on risk assessment. Types of audit. Drafting an audit plan: setting goals, selecting the team, conducting the audit and evaluating the process, synthesizing the findings and feedback for the auditee.

11. *Calification, Validation and Calibration*. Process performance and capability. (see Q8, Q9 and Process Validation)

12. Standard File of a Production Unit.

Seminar activities

1. Drawing up the Quality Manual of a virtual company.
2. Drawing up the Standard File of a Production Unit at a virtual company.
3. Drawing up the Quality Assurance specific documentation for a virtual company:
   - System Procedures
   - Standard Operation Procedures
   - Working instructions
   - Specifications: intermediate and bulk product, finished product release, finished product at the end of shelf life & analytical methods
   - Certificate of Analysis
   - Manufacturing Formula & Processing & Packaging Instructions
   - The Serial Processing File
   - Registrations - Management on paper or electronic support
   - Series certification procedure
4. Drawing up technical contracts for subcontracting:
   - Technical - manufacturing contract (partial or total subcontracting of the manufacturing)
   - Technical contract - series analysis (partial or total subcontracting of the batch release testing)
   - Technical service - series certification
5. Drawing up an audit program based on risk analysis.
6. Product Quality Analysis

Objectives

1. To know and understand the principles of the Quality Assurance concepts in the pharmaceutical industry.
2. To know the aspects that define the quality of industrial drug produscts.
3. To understand the role of the Quality Assurance System for the quality of industrial drug products.
4. To know the national and European regulatory documents on Quality Assurance in the pharmaceutical field.
5. To know how to organize a Quality Assurance system in the pharmaceutical industry.
6. To know the way and the means to apply in practice the principles of the Quality Assurance System in the pharmaceutical industry.
7. To know how to prepare specific documents of the Quality Assurance System.

Content of the study program

3rd semester

Statistics and Multivariate Analysis of Experimental Data

Course lecture

1. Introduction to statistics: Types of data; Elements of descriptive statistics (centrality, dispersion); Sampling. Confidence intervals.

2. Hypothesis Testing, Statistical Tests, Analysis of Variance, Correlations, Simple and Multiple Regression.

3. Multivariate versus univariate analysis. Projection methods in multivariate analysis of experimental data. Primary evaluation of experimental data. Interpretation of models: outliers, scores, weights.

4. Multivariate regression methods: projection methods (PLS, OPLS), artificial neural networks. Performance Parameters: R2, Q2, RMSECV, RMSEP.

5. Discrimination and Classification. Identifying discriminatory variables.

6. Statistical Process Control. Time series analysis. Batch Modeling principles: multivariate models to correlate the evolution of process parameters with quality attributes of medicinal products.

7. What is PAT and why is it necessary? Types of PAT tools (in-line, on-line, at-line, off-line) and their implementation for real-time predictions of CQAs. Calibration strategies for PAT instruments, the importance of robustness to formulation and process factors.

Seminar activities

1. Types of variables. Statistical parameters of centrality, dispersion, normality. Data distributions and their processing. Central tendency comparison: Z test, t student, ANOVA, ANOVA 2 with / without replication. Comparison of dispersion degree: F test.
2. Introduction to Multivariate Analysis of Experimental Data: Projection Methods – Principal Component Analysis. Construction, analysis and interpretation using dedicated computer programs: importance of data scaling (Ctr, UV, Par); scores and weights; identify aberrant observations (HotelingT2, DmodX test).
3. Multivariate regression models: PLS, OPLS. Construction, analysis and interpretation using dedicated computer programs: scaling of input and output; identifying predictive variables; Interpretation through graphical means and performance parameters (R2, Q2, RMSECV); Optimization opportunities; Independent Data Model Testing (RMSEP).
4. Statistical and multivariate methods for monitoring drug manufacturing processes: tracking the evolution over time of some descriptors (MBSD, moving F test, PCA), possibilities to identify deviations from normality.
5. Strategies for combining data originating from different sources through hierarchical modeling: compression of data through scores (PCA), predictive / orthogonal scores, and construction of predictive models on product quality.

7 ECTS credits

Coordinator:

Prof. Ioan TOMUȚĂ, PhD

– UMF "Iuliu Haţieganu" –

Collaborator:

Asst. prof. Tibor CASIAN, PhD

– UMF "Iuliu Haţieganu" –

Objectives

1. Presentation of the principles underpinning multivariate data analysis and correct statistical interpretation of the results obtained in the research activity

2. The acquisition by students of the terminology and principles underpinning statistical tests

3. The acquisition by students of the terminology and principles underlying multivariate data analysis: organization, processing, performance descriptors of developed models, interpretation.

4. The acquisition by students of the advantages regarding the collection of data from numerous sources (BigData).

5. Providing knowledge related to the construction, analysis and interpretation of models with different applications (linear / non-linear regression, classification, discriminatory analysis, hierarchical models).

6. To provide knowledge on the use of statistics in multivariate analysis.

7.To acquire the ability to generate high quality scientific reports.

Content of the study program

3rd semester

Drug Quality Control

Course lecture

1. Quality Control (QC) Compliance of QC Laboratory & Quality Assurance (QA) Aspects Relevant in QA. Regulatory Requirements for Analytical Labs and QC (EU/US). GMP compliant documentation. Pharmacopoeial reference standard. Specifications. Test procedures, Methods validation. SOPs, etc. Data handling of (paper, electronic, hybrid) and laboratory data integrity. Analytical results handling (raw data, raw data check, averaging, rounding of results). Change control systems (regulatory framework and practical implementation). Release of APIs, excipients, packaging materials, finished products. CAPA (Corrective Actions and Preventive Actions). Managing out of specification and out of trend results: ICH/ EMA/FDA guidance; procedures and handling of OOS/OOE/OOT results; practical approach for managing OOS results, practical approach for managing OOT results. Defining responsibilities for analysts, head of analytical lab, QPs. Personnel training: GMP training, procedure training, training records.

2. *Analytical Instrument Qualification and Calibration,* Key recommendations. Validation Master Plan - calibration management. Definition of DQ, IQ, OQ and PQ. Documentation. Inventory/instrument master data. Calibration scheduling and tracking. Examples of protocols and documents. Instrument performance history. Calibration standards. Calibration interval adjustment. Out of tolerance evaluation. Practical approaches to qualification and calibration of different apparatus: UV-Visible, Dissolution, Disintegration, GC instrument, Balances and Weighing Processes, HPLC / Chromatography Data Systems

3 *Reference Standards and Sampling Procedure*. Pharmacopeial reference standards: handling and re-use. Procedure for qualification of a primary/secondary reference standard. Assigning purity values to reference standards and practical example of calculation. Sampling procedure and sampling plans. Regulatory requirements. Sampling of incoming APIs, incoming excipients, in process and finished dosage forms. GMP-compliant documentation of sampling operations. Sample preparation methods used in pharmaceutical.

4. *Transfer of Analytical Methods and Analytical Method Comparison*. Regulatory Requirements (EU / USP GMP and regulation). Statistical Tests. Analytical significance vs statistical significance. Acceptance criteria setting. Interval hypotheses. Method comparison–equivalence testing of two methods.

5. *Stability Testing Program*. Overview of ICH storage condition for new drugs. World climatic zones for drug stability storage. Common degradation reactions of APIs and excipients. Impurities and degradation products resulting from reactive APIs and excipients. How to ensure chromatographic detection of all degradation products. Photodegradation. Innovative and generic drugs stability testing plan. Stress testing/forced degradations of drug substance and product to support shipping/distribution. Mean kinetic temperature. Shelf life calculation. Presenting stability data. Handling derivation of shelf life.

6. An overview of the most important *chromatographic and electrophoretic techniques* used in drug analysis: thin-layer chromatography, high performance thin-layer chromatography, high-performance liquid chromatography, gas chromatography, capillary electrophoresis and related techniques.

7. *Molecular absorption spectrometry in drug analysis*. UV-Vis, FT-IR, FT-NIR, FT-Raman and NMR spectrometry, fundamentals and practical aspects.

8. *Thermal Techniques Used in Drug Analysis*. TGA, DSC, DTA, HSM. Fundamentals and practical aspects.

9. *Microbiological Drug Testing*. Microbiological testing of pharmaceutical substances, excipients, finished products and clean rooms. Sterility tests on pharmaceutical substances/materials and pharmaceutical products. Pyrogens and bacterial endotoxins tests in pharmaceutical products. Microbiological methods applied for the activity assay of antibiotics in pharmaceutical preparations.

10. *Quality Control of Raw Materials* (APIs and Excipients). Regulatory and GMP Requirements for APIs and Excipients analysis. Relevant ICH/FDA/EMA guidelines. CEPs. Implementation of pharmacopoeial monographs in your laboratory. Multi-compendial testing. Validation of pharmacopoeial testing methods. Reduced testing of supplied APIs and excipients. GMP aspects of supplier/manufacturer qualification. Role of the raw materials laboratory within the pharmaceutical supply chain. Risk assessment for excipients. Quality *Control of intermediate (in-process control) and finished medicine products (finished dosage forms)*. Regulatory and GMP Requirements for finished dosage forms analysis. Implementation of pharmacopoeia monographs. Multi-compendial testing. Validation of pharmacopoeial testing methods. Reduced Testing. In process control. Risk assessment for finished dosage forms control.

Laboratory activities

1. Inhouse practical development of a chromatographic/electrophoretic/spectroscopic method for drug analysis with applications in the pharmaceutical industry.
2. Validation of the developed analysis method. Statistical analysis of the experimental data generated in the validation process.
3. Practical application of developed and validation method for analysis of raw materials (excipients/API), intermediate, finished dosage forms. Experimental data analysis and interoperation.
4. Development and using of TGA, DSC methods and their application in drug analysis.

6 ECTS credits

Coordinator:

Prof. Ede BODOKI, PhD

– UMF "Iuliu Haţieganu" –

Collaborators:

Prof. Radu OPREAN, PhD

Lecturer Bogdan Cezar IACOB, PhD

– UMF "Iuliu Haţieganu" –

Assoc. prof. Horaţiu MIREŞAN, PhD

– Magistra C&C Romania , Quality Control Director –

Balázs SZANISZLÓ, PhD

– LEO Pharma, Denmark –

Objectives

1. To know the principles of drug quality control.
2. To acquire in-depth knowledge of the quality of industrial drug products.
3. To acquire in-depth knowledge on drug quality control (QC laboratory compliance, references standards, sampling procedures, analytical instruments qualification and calibration, analytical procedures compliance, quality control of raw materials, intermediate product, finished doasge forms) in pharmaceutical industry.
4. To acquire knowledge about specific regulations in the field of drug quality control.

Content of the study program

3rd semester

Optional courses - the students must follow one of them (5 ECTS credits)

PHARMACEUTICAL TECHNOLOGY II (PHARMACEUTICAL DOSAGE FORMS)*

Course lecture

1. Pharmaceutical Technology - Introduction. General considerations regarding Formulation, Preparation and Quality of Dosage Forms.
2. Liquid pharmaceutical preparations: Solutions. Formulation and preparation of oral solutions; aqueous, nonaqueous solutions; syrups.
3. Liquid pharmaceutical preparations: formulation and preparation of solutions with external application (cutaneous, nasal, otic, ophthalmic solutions, gargles, mouthwashes, enemas, irrigation solutions).
4. Parenteral preparations. Parenteral routes of administration. Sterilization. Types of preparations. Parenteral combinations. Formulation, preparation and quality conditions of injectable drugs. Intravenous admixtures: formulation, preparation and quality conditions. Total parenteral nutrition.
5. Heterogeneous liquid dispersion systems. Classification. Emulsions: formulation, preparation, properties and stability. Suspensions: classification, formulation, preparation, quality considerations.
6. Dosage forms and drug delivery systems for topical application: semisolid preparations for skin applications. Drug effects and the extent of percutaneous drug delivery. Classification and properties of ointment base. Ointment formulation, preparation and quality considerations. Transdermal drug delivery systems.
7. Dosage forms and drug delivery systems for topical application: Suppositories. Rectal and vaginal absorption. Suppository bases. Methods of dispersing drug substances. Quality considerations.
8. Aerosols. Inhalations and inhalants. Applications, formulations, production, packaging, administration.
9. Powders as a dosage form. General features, advantages, formulation, quality considerations. Preparation: methods and special problems. Granulation: advantages, methods of preparation.
10. Hard gelatin capsules. Soft elastic capsules. General features, formulation, preparation, advantages, quality considerations. Other oral solid dosage forms.
11. Tablets. Tablet types. Immediate release tablets: general features, formulation, preparation, quality considerations, uses.
12. Tablets. Modified release tablets: general features, formulation, preparation, quality considerations, uses.
13. Targeted delivery systems. Examples. General features, formulation, preparation, quality considerations, uses.

Laboratory activities

1. Formulation, preparation and pharmacotechnical analysis of liquid dosage forms: solutions, emulsions, suspensions.
2. Topical dosage forms: Semisolid preparations and suppositories: formulation, preparation and pharmacotechnical analysis.
3. Powders. Preparation of oral powder. Preparation of powder for external use and powder with special problems. Quality analysis.
5. Capsules: formulation, preparation, quality analysis.

**** Course recommended for students with bachelor studies in medicine, biology, chemistry, physics, engineering, mathematics, etc.***

Coordinator:

Assoc. Prof. Elena DINTE, PhD

– UMF "Iuliu Haţieganu" –

Collaborators

Asst. prof. Lucia TEFAS , PhD

– UMF "Iuliu Haţieganu" –

Objectives

1. To provide knowledge of dosage forms in terms of formulation, preparation and quality conditions.
2. To understand the scientific principles of drug formulation.
3. To understand the methods of drug preparation.
4. To understand the importance of the quality of the dosage forms in relation to the pathways of the route of administration.
5. To understand the influence of formulation and preparation on the quality, safety and efficacy of the drug.

Content of the study program

3rd semester

Optional courses - the students must follow one of them (5 ECTS credits)

NATURAL PRODUCTS – FROM ISOLATION TO PHARMACEUTICAL PRODUCTS**

Course lecture

1. Drugs from nature. The diversity of natural molecules. Natural molecules used today as drugs. Historical aspects and future perspectives.
2. Herbal drugs versus herbal dietary supplements. The need for standardization and quality control of herbal medicines. Clinical cases of herbal drugs adulteration and the need of botanical authentication in herbal drug development.
3. Methods in assessing the botanical control of the primary sources of herbal drugs for industry. The need for standardization.
4. European Pharmacopoeia and herbal drugs quality. The need for quality for herbal drugs without monographs. Perspectives for industry.
5. Laboratory scale in natural products development: from the natural source to the final extract/fraction/molecule.
6. From lab to industry: natural products in drug development for industry.
7. Herbal dietary supplements versus herbal drugs. An industrial perspective for pharmaceutical products using medicinal plants and fungi.
8. Natural products in the current pharmaceutical practice. Future perspectives and challenges.

Laboratory activities

1. Herbal drug development: from the botanical source to a final product. The need of new pharmaceutical forms.
2. Herbal drug development in the context of safety and efficacy. Quality control and correct botanical identity. Extraction and methods of analysis. Isolation versus the phytocomplex. How to obtain a pharmaceutical products from natural matrices.
3. Industrial development peculiarities of herbal drugs.

***** Course recommended for students with bachelor studies in pharmacy***

Coordinator:

Assoc. Prof. Andrei MOCAN, PhD

– UMF "Iuliu Haţieganu" –

Objectives

1. To know the principles of developing the manufacturing technology and quality control assurance for drug products containing natural extracts, compounds or fractions.
2. To acquire the scientific principles underlying the conception, design, manufacture and quality control of herbal drugs.
3. To acquire in-depth knowledge on the importance of correctly identifying the natural matrices used further in drug development.
4. To acquire in-depth knowledge of the quality of industrial herbal drug products.
5. To acquire knowledge about specific rules used in herbal drugs development, methods used in quality control and methods used in assessing the botanical identity of natural matrices.

Content of the study program

4th semester

Intellectual Property in the Pharmaceutical Field

7 ECTS credits

Course lecture

1. Intellectual property - brief history. Internal and international organizations - State Office for Inventions and Trademarks (OSIM/SOIT), European Union Intellectual Property Office (EUIPO), European Patent Office (EPO), Romanian Copyright Office (ORDA/RCO), World Intellectual Property Organization (WIPO). Fundamental legislative principles.
2. The importance and current situation of intellectual property rights. Types of intellectual property - patent, copyright, trademark. Examples in the pharmaceutical industry regarding the economic impact of patents. Filing a patent costs.
3. Conditions for patentability. Databases used for patent search.
4. How to read and interpret a patent. Types of patents - process or method patents (patents of new products, patents of new uses, formulation patents), design patents.
5. The patent process. How to write a patent. Patent structure and content. Patent language. Patent claims.
6. Patent application rejection (refusal). Reasons for rejection (refusal).
7. Patent rights. How long does patent protection last? Transmission and defense of patent rights.

Laboratory / seminar activities

1. Presentation of national and international organizations dealing with the protection of intellectual property rights.
2. Examples of patents in the pharmaceutical industry. Patent search in national and international databases. Reading and interpreting a patent.
3. Writing a patent.

Coordinator:

Prof. Ioan TOMUȚĂ, PhD

– UMF "Iuliu Haţieganu" –

Collaborator:

Asst. prof. Dana HALES, PhD

– UMF "Iuliu Haţieganu" –

Objectives

1. Presentation of underlying principles of intellectual property protection in the pharmaceutical field through patents.
2. To provide knowledge/ information on patent search in specific databases.
3. To provide knowledge/ information on reading and interpretation of patents.
4. To provide knowledge on the legal framework, specific to intellectual property.
5. Students must acquire the principles of intellectual property protection in the pharmaceutical field.
6. Students must acquire the methodology of patent filing.

Professional Practice

⇒ 6 weeks in pharmaceutical industry at an agreed partner.

⇒ The university has signed professional practice protocols with the following pharmaceutical companies: Antibiotice, Sandoz Romania, Gedeon Richter Romania, Terapia, AC. Helcor, Rompharm, PlantExtract, Laropharm, STADA Hemofarm, VimSpectrum.

⇒ It can be accomplished within an ***Erasmus mobility*** for master students. The university has signed Erasmus exchange partnerships with: Research Centre in Pharmaceutical Engineering (Graz, Austria), Ghent University (Ghent, Belgium), University of Liège (Liège, Belgium), University of Mons (Mons, Belgium), University of Antwerp (Antwerp, Belgium), Szeged University (Szeged, Hungary), Budapest University of Technology and Economics (Budapest, Hungary).

⇒ The university is open to develop new partnerships with other interested partners on pharmaceutical industry.

Dissertation Thesis Preparation

- To graduate the study program students must write and publicly defend a dissertation thesis.
- The thesis is written based on an original personal research in the field of interest of the student.
- The thesis is performed under the supervision of a teacher from UMF or an associated teacher.
- Choosing the subject in the area where the students work or want to work is highly recommended.
- The thesis must prove the following abilities of the student:
  - capacity to do in deep documentation in a specific area;
  - knowing the scientific concepts in the area of the drug development and manufacturing;
  - practical application of the theoretical knowledge acquired during the study program;
  - adequate using of the language and the terminology;
  - formulating research hypotheses and testing them;
  - arguing the conclusions based on results;
  - drawing and writing a scientific paper.

ERASMUS MOBILITIES

4th semester

Erasmus+ Programme is an initiative of European Union to support education, training, youth and sport in Europe. It provides the opportunity for the students to study or gain relevant experience in a different European country while completing a degree study.

Through the Erasmus+ the students at this Master program have the possibility of studying or doing an internship for a period of 3 months (in the 4th semester), in another country at a partner institution. Students receive a grant, which is a contribution to travel and the cost of living and studying or traineeship to gain work experience in another country. They are selected for Erasmus+ Mobility on the basis of their academic performance and the relevance of the proposed study or internship plan.

By following an Erasmus+ mobility, students may improve they communication, language and inter-cultural skills and gain soft skills highly valued by employers. The students may combine the studying period with a traineeship to gain work experience, often more important for the new entrants on the job market.

Coordinator:

Prof. Ioan TOMUȚĂ, PhD

– UMF "Iuliu Haţieganu" –

Collaborator:

Prof. Ede BODOKI, PhD

– UMF "Iuliu Haţieganu" –

Partner institutions

Ghent University
Faculty of Pharmaceutical Sciences (*Belgium*)

University of Liège
Department of Pharmaceutical Sciences (*Belgium*)

University of Mons
Faculty of Medicine and Pharmacy (*Belgium*)

University of Antwerp
Department of Pharmaceutical Sciences (*Belgium*)

Research Center Pharmaceutical Engineering (RCPE) (*Austria*)

University of Szeged
Faculty of Pharmacy (*Hungary*)

Budapest University of Technology and Economics
Department of Organic Chemistry and Technology

Louisiana State University
Organic, Polymer, and Bio-analytical Materials Chemistry

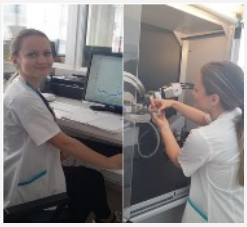
TESTIMONIALS

Ioana SAVENCU - 2019 Graz, Austria

During this master I had the opportunity to go to the Research Center Pharmaceutical Engineering (RCPE) in Graz, through an Erasmus. At RCPE you have the chance to perform cutting-edge research at the interface between university research and industry. My research work was organized as master thesis and was part of a project that developed lipid inhalable microparticles for systemic drug delivery through the lungs. Apart from the benefit of professional experience, I also had the opportunity to improve my German language, make new connections and enjoy the beauty of Austria during spring time. Graz is a beautiful city with many tourist attractions and it also has awesome nature around to enjoy. If you think of applying for an Erasmus mobility, be it in Austria or in another country, I would definitely encourage you to do so. Although initially things might seem complicated, you will enjoy the gain later. Personally, at first, I was also not sure whether all this Erasmus thing is worth the effort, but looking back I am really grateful for the entire experience I had there.

Iulia STĂNESCU - 2017 Erasmus Graz, Austria

During my Master studies, I had an amazing opportunity to spend 3 months in Graz and to be part of a multidisciplinary team. The Erasmus experience was not new to me and I was sure that it will be both challenging and entertaining. I did not know Graz , but after my arrival I found out it was a very beautiful city with very kind and nice people. The company was very professional and welcomed me the day I've arrived. Working together with pharmacists, physicists and pharmaceutical engineers was new to me and helped me in developing professional and social skills. I would warmly recommend Erasmus exchanges to all students in order explore new options and possibilities.



Andrea-Gabriela CRISAN - 2017 Szeged Hungary

My Erasmus experience at Szeged, University, was challenging and highly fullfiling, both professionally and culturally. It represented the perfect opportunity to learn from experts of the Institute of Pharmaceutical Technology and Regulatory Affairs and exchange ideas in the field of research. Moreover, I built connections and friendships that will last for a lifetime. Although the extent of the Erasmus mobility was short (April-June 2017), it was truly a catalyzer for further pursuing doctoral studies.

More information

Faculty of Pharmacy

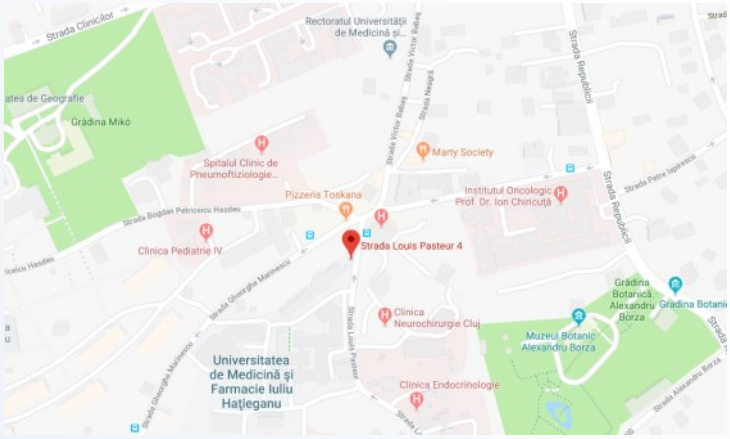
4 Louis Pasteur Street, 2nd floor
400349 Cluj-Napoca
Phone: +40-264-406-845
Fax: +40-264-597-257
Email: decanat_farma@umfcluj.ro

Director of Master Study Program

Prof. Ioan TOMUȚĂ, PhD
Department of Pharmaceutical Technology and Biopharmacy
41 Victor Babeș Street
400012 Cluj-Napoca
Tel: +40-374-834-846 /+40-374-834-844
Email: tomutaioan@umfcluj.ro

http://www.farmacie.umfcluj.ro/educatie-farma-ro/masterat-fa-ro

https://www.facebook.com/master.IndustrieFarmaceutica/



Printed in December 2019

UMF
UNIVERSITATEA DE MEDICINĂ ȘI FARMACIE IULIU HAȚIEGANU CLUJ-NAPOCA