FACULTY OF PHARMACY

STUDY PROGRAM 0916.1 PHARMACY

DEPARTMENT OF PHARMACOLOGY AND CLINICAL PHARMACY

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum Faculty of Pharmacy
Minutes No. 2 of 09.11.2021
Chairwoman of the Committee, PhD, associate professor
UNCU Livia _____

APPROVED
at the meeting of the Faculty Council, Faculty of Pharmacy
Minutes No. 3 of 16.12.2021
Dean of the Faculty, PhD, associate professor
CIOBANU Nicolae _____

APPROVED
approved at the meeting of the Department of Pharmacology and Clinical Pharmacy
Minutes No. 2 of 15.09.2021
Head of Department, PhD, associate professor,
SCUTARI Corina _____

SILLABUS

DISCIPLINE: **PHARMACOGENETICS**

Integrated studies

Type of course: **Optional discipline**

Curriculum developed by the team of authors:

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I. PRELIMINARY

- General presentation of the discipline: its place and role in specific competences formation of professional/specialty training program

The course of *Pharmacogenetics* is a component of pharmaceutical education and aims to detect, diagnose, treat and recover patients with genetic diseases and those with birth defects and estimate the risk of recurrence of genetic diseases in patients' families and provide correct and competent genetic advice.

During the lectures are presented the general notions about population genetics and public health, genetic diseases; general characteristics and study methods, principles of prophylaxis and treatment of genetic diseases: The aim of the course is to determine the factors that influence the occurrence of genetic diseases in human populations, on the one hand and the genetic approach in medicine, on the other hand. Healing of the patient is achieved through genetic therapy strategies (methods that act at the phenotypic level, treatment of associated biochemical disorders, methods aimed at deficient protein levels, pharmacological modulation of gene expression, cell therapy), gene therapy (somatic gene therapy, germ therapy). This course will contribute to the acquisition of the basic principles of drug treatment of diseases with a genetic component and to the exercise of advisory assistance to physicians and patients on the performance of effective and harmless medication.

- Mission of the curriculum (aim) in professional training

The mission of the optional course is to formulate a broad conception of the phenomena that have direct / major implications in the practice of medical genetics; clinical approach of patients with common diseases - with genetic predisposition, birth defects, hereditary and familial cancers. Courses and practical works will include notions about genetic variability, the influence of genetic variability on the pharmacokinetics of drugs. The general principles of treatment of immune, cardiovascular, respiratory, kidney, neurodegenerative, neoplastic, viral, etc. genetic diseases will be adopted. The mission of the optional course of pharmacogenetics is to determine the role of the pharmacist in personalized therapy of genetic diseases and the prophylaxis of diseases with genetic component.

- **Languages of the course:** Romanian, English.
- **Beneficiaries:** students of the fourth year, faculty of Pharmacy, specialty of Pharmacy.

II. MANAGEMENT OF THE DISCIPLINE

Code of the discipline		**S.07.A.060.2**	
Name of the discipline		**Pharmacogenetics**	
Person(s) in charge of the discipline		PhD, associate professor, **Cazacu Vasilii**	
Year	**IV**	Semester	**7**
Total number of hours, including:			**60**
Lectures	**15**	Practical/laboratory hours	**-**
Seminars	**30**	Individual work	**15**
Form of assessment	**E**	Number of credits	**2**

III. TRAINING AIMS IN WITHIN THE DISCIPLINE

At the end of the discipline study, the student will be able to:

✓ ***At the level of knowledge and understanding:***

- To know the definition, classification and general notions about genetic variability;
- to know the influence of genetic variability on drug metabolism;
- to know the influence of genetic variability on drug carriers;
- to know the genetic variability of common genetic diseases;
- to know the genetic variability and medication of the cardiovascular system, neurodegenerative diseases, antineoplastic medication, antiviral medication;
- to learn the ethical, social and economic implications of genetic variability.

✓ ***At the application level:***

• To be able to provide advisory assistance to physicians and patients regarding the pharmacotherapy of genetic diseases, as well as to prevent the genetic variability associated with a particular response to drugs;
• to reduce the morbidity caused by genetic predisposition;
• to appreciate the cardinal manifestations of the cardiovascular, respiratory, digestive, renal, immune, oncological, neurological genetic diseases;
• to apply the principles of prophylaxis of diseases with genetic component;
• to apply the general principles of treatment of genetic diseases and strategies of therapy of genetic diseases (methods that act at phenotypic level, treatment of associated biochemical disorders, methods aimed at deficient protein levels, pharmacological modulation of gene expression, cell therapy), gene therapy (somatic gene therapy, germ therapy).

✓ ***At the integration level:***

- To interpret the general notions about genetic variability, clinical manifestations, methods of risk assessment and prognosis of genetic pathology;
- To adequately select predictive diagnostic tests for genetic diseases and advise patients on the benefits, limitations and risks of these tests;
- to determine the main directions and objectives of genetic disease medication;
- to be able to analyze genetic disease therapy strategies;
- to characterize the treatment methods that act at phenotypic level, the treatment of associated biochemical disorders, cell therapy;
- to evaluate and predict genetic variability on possible adverse drug effects;
- to draw up a plan for the investigation, diagnosis and care of a patient with a specific type of genetic disease.

IV. PROVISIONAL TERMS AND CONDITIONS

Student of the Fourth year requires the following:

- Certified skills in fundamental sciences (physiology, pathological physiology, biochemistry, toxicological chemistry, toxicological plants, pharmacology);

- Digital competences (use of the Internet, document processing, electronic tables and presentations, use of graphics software);
- Ability to communicate and team work;
- Qualities - tolerance, compassion, autonomy.

V. THE MESAND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/seminars and self-training

No	Theme	Number of hours		
		Lectures	Practical works	Self training
1.	Introduction: the role of pharmacist in personalized therapy.	1	2	1
2.	Genetic variability, definition and clarifications.	1	2	1
3.	Influence of genetic variability on drug metabolism (phase I enzymes - CYP450)	1	2	1
4.	Influence of genetic variability on drug metabolism (phase II enzymes)	1	2	1
5.	The influence of genetic variability on drug transporters	1	2	1
6.	Genetic variability and the immune system (hypersensitivity reactions, transplant medication and vaccines)	1	2	1
7.	Genetic variability and medication of the cardiovascular system I (anticoagulants, antiplatelet agents, lipid-lowering drugs)	1	2	1
8.	Genetic variability and medication of the cardiovascular system II (beta blockers, renin-angiotensin-aldosterone blockers, calcium channel blockers)	1	2	1
9.	Genetic variability and antineoplastic medication I.	1	2	1
10.	Genetic variability and antineoplastic medication II	1	2	1
11.	Genetic variability and neuroleptic and antidepressant medication	1	2	1
12.	Genetic variability and medication of neurodegenerative diseases - Alzheimer's disease, Parkinson's disease	1	2	1
13.	Genetic variability and antiviral medication	1	2	1
14.	Genetic variability - ethical, social and economic implications	1	2	1
15.	Prophylaxis of genetic diseases: main directions; genetic counseling; prenatal diagnosis.	1	2	1
Total		**15**	**30**	**15**

VI. CLINICAL SKILLS ACQUIRED AT THE END OF THE COURSE

- To be able to provide advisory assistance to physicians and patients regarding the pharmacotherapy of genetic diseases, as well as to prevent the genetic variability associated with a particular response to drugs;
- to reduce the morbidity caused by genetic predisposition;
- to appreciate the cardinal manifestations of the cardiovascular, respiratory, digestive, renal, immune, oncological, neurological genetic diseases;
- to apply the principles of prophylaxis of diseases with genetic component;
- to apply the general principles of treatment of genetic diseases and strategies of therapy of genetic diseases (methods that act at phenotypic level, treatment of associated biochemical disorders, methods aimed at deficient protein levels, pharmacological modulation of gene expression, cell therapy), gene therapy (somatic gene therapy, germ therapy).

VII. REFERENCE OBJECTIVES AND CONTENT UNITS

OBJECTIVES	CONȚENT UNITS
Chapter 1. The influence of genetic variability on drugs.	
✓ To define genetic variability and to know the principles of its classification. ✓ to know the influence of genetic variability on drug metabolism (phase I enzymes - CYP450) ✓ to know the influence of genetic variability on drug metabolism (phase II enzymes) ✓ to know the influence of genetic variability on drug carriers.	Genetic variability - the property of living beings to change (under the influence of environment and heredity, external and internal factors), their morphological, physiological, biochemical, ecological properties, to differ from each other. Causes and sources of variability. Mutation and types of mutation. Examples of genetic variability. The role of genetic factors in drug metabolism. The role of genetic factors on drug carriers.
Chapter 2. Genetic variability and medication of genetic diseases of the immune, cardiovascular, neoplastic system.	
✓ to know the clinical and laboratory manifestations of pancreatic disorders; ✓ to learn the clinical picture and laboratory values of stomach and duodenal diseases; ✓ to know the clinical and laboratory manifestations of hepato-biliary diseases; ✓ to know the subjective and objective manifestations, the values of the laboratory tests of the urinary tract; ✓ to learn the clinical symptoms and laboratory values of respiratory system diseases.	Pancreatitis. Cholecystitis. Gastritis. Gastro-duodenal ulcer. Diarrhea. Constipation. Acute and chronic hepatitis. Hepatic cirrhosis. Acute respiratory infections. Bronchitis. Pneumonia. Bronchial asthma. Pyelonephritis. Glomerulonephritis. Nephrolithiasis. Kidney failure.
Chapter 3. Genetic variability and medication of genetic diseases of central nervous system, antiviral medication.	

OBJECTIVES	CONȚENT UNITS
✓ To study genetic variability and neuroleptic and antidepressant medication ✓ to know the genetic variability and medication of neurodegenerative diseases - Alzheimer's disease, Parkinson's disease ✓ to study genetic variability and antiviral medication ✓ to learn the ethical, social and economic implications of genetic variability ✓ to know the methods of prophylaxis of genetic diseases	Genetic variability and neuroleptic and antidepressant preparations. Genetic variability and medication for Alzheimer's and Parkinson's diseases. Genetic variability and antiviral preparations. Main directions; genetic counseling and prenatal diagnosis of genetic diseases.

VIII. PROFESSIONAL (SPECIFIC (PS)) AND TRANSVERSAL (TC) SKILLS AND STUDY OTCOMES

✓ Professional Skills (PS)

PS1: knowledge, explanation and interpretation of the influence of genetic variability on drugs, knowledge of the influence of genetic variability on drug metabolism and drug carriers, problem solving and drawing conclusions.
PS2: knowledge of the pharmacodynamic and pharmacokinetic properties of drugs used in genetic diseases, knowledge and explanation of the selection of main drug groups, drug preparations (essential), optimal doses, routes and method of administration.
PS3: the use and adaptation of knowledge in the field of pharmacogenetics in advising patients on the factors that determine genetic variability and genetic diseases, the diagnosis of genetic diseases and those with genetic predisposition; knowledge of treatment strategies and how to access and select materials online.
PS4: partaking into the scientific research circle and presenting individual scientific projects with new results in the field of pharmacogenetics.
PS5: knowledge of the methodology of clinical research of the influence of genetic variability on drugs; identification of scientific research problems in the field of pharmacogenetics, scientific correlation with biopharmaceutical and biomedical knowledge
PS6: the use of problem-solving skills, clinical cases, use of information technologies to solve tests and render the etiopathogenesis, symptomatology, diagnosis and medication of genetic diseases and those with genetic predisposition from the curriculum to the optional discipline through digital technologies.

✓ Transversal Skills (TS)

TS 1: Promoting laboratory analyzes necessary for the patient to establish the correct diagnosis; compliance with pharmaceutical ethics and deontology rules in interpreting laboratory tests.
TS 2: Formation of personal attitude; the interaction ability of pharmacist-patient, pharmacist-doctor types, group-efficient activity with different counseling roles; improving the decision-making autonomy in the preservation, selection and release of drugs aiming to normalization of laboratory values.
TS 3: Performing teamwork by carrying out scientific projects; promoting the spirit of initiative, dialogue and cooperation through various techniques of acquiring the material; critical analysis and formulation of conclusions to the pharmacist's daily activity.

✓ Study Outcomes

At the end of the course the student will be able to:

- To evaluate the importance and role of pharmacogenetics in the context of general medicine and integration with related pharmaceutical disciplines.
- To be able to optimize the diagnosis by the appropriate choice of predictive diagnostic tests in case of genetic diseases.
- To apply the knowledge of pharmacogenetics in the ability to explain the etiopathogenesis, symptomatology and evolution of the genetic condition.

- To apply pharmacogenetic knowledge in the ability to explain the main directions and objectives of genetic disease medication.
- To possess the ability to synthesize and integrate factual material from multiple sources and the appropriate use of bibliographic information (including those provided through Medline and Internet networks) in order to establish the correct diagnosis and proper monitoring of patients.
- To inform the patient about the rational use of the drug, possible side effects, prophylaxis and control.
- To have the ability to carry out a plan for the investigation, diagnosis and care of a patient with a specific type of genetic disease.
- To have the ability to recognize one's own professional limits and the need to collaborate with other specialists.
- To be able to use critically and confidently the scientific information obtained using new information and communication technologies.

IX. STUDENT'S INDIVIDUAL WORK

No.	Expected Produc	Implementation Strategies	Assessment criteria	Implementation terms
	Working with information sources:	Read the lecture or the material in the manual to the theme carefully. Reading self-training questions in the subject that require reflection on the matter. To get acquainted with the list of additional information sources on the topic. Select the source of additional information for that theme. Reading the text entirely, carefully and writing the essential content. Wording of generalizations and conclusions regarding the importance of the theme/subject	Ability to extract the essentials; interpretative skills; the volume of work	During the semester
	Working with the practical hours' notebook:	Until solving the tasks in the notebook, analyze the information on the subject in the lecture and the manual. Solving consecutive tasks: brief characterization of laboratory data in various pathological conditions, solving clinical cases with explanation of laboratory data. Selection of additional information, using electronic addresses and bibliographic sources.	Workload, situational problem solving skills, ability to formulate conclusions	During the semester
	Preparing and defending presentations /portofolios:	Selection of the research theme, establishment of the research plan, setting the terms of realization. Establishing PowerPoint presentation components - theme, purpose, results, conclusions, practical applications, bibliography Peer reviews. Teacher reviews	The volume of work, the level of insight into the essence of the presentation, the level of scientific argumentation, the quality of the conclusions, the elements of creativity, the formation of the	During the semester

No.	Expected Produc	Implementation Strategies	Assessment criteria	Implementation terms
			personal attitude, the coherence of the exposure and the scientific correctness, the graphic presentation, the way of presentation	

X. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

Teaching and learning methods used

The teaching of the discipline Pharmacogenetics uses different teaching-learning-assessment methods and procedures, oriented towards the efficient acquisition and achievement of the objectives of the didactic process. At the lectures, along with traditional methods (lesson-exposure, lesson-conversation, synthesis lesson), modern methods (lesson-debate, lecture-conference, problem-lesson) are also used. During practical works are used following forms of activities: individual, frontal, group-based. Control work (characterization of preparations, indications in intoxications with various preparations) in writing to highlight the initial level of knowledge. Practical activities (group work): solving of situational problems and clinical case studies, demonstration of video films. During lessons and extracurricular activities are used Communication Technologies - PowerPoint presentations.

Verifying knowledge on questions from methodological guidelines and putting tasks on the next topic of practical works (self-training homework).

Final: exam (semester IX).

- ***Applied teaching strategies/technologies (specific to the discipline);***

"Brainstorming", "The round table"; "Case Study"; "Portfolio".

Methods of assessment *(including the method of final mark calculation).*

Current*:* frontal and/or individual control via:

- Motivation (current topic). Determining the purpose of practical works, answering students' questions.
- Written control (test) to highlight the initial level of knowledge.
- Practical Activities: Solving of Problems and Questions in Methodological Instructions for Laboratory Work in *Pharmacogenetics*.
- Verification of final knowledge and assignment of tasks for the next topic of the practical work (self-training).

During the study year, there are two totalizations at the discipline Pharmacogenetics. At the end of semester, the student's self-training work is graded.

Thus, formative evaluation consists of two totalizations and one mark for self-training work.

The annual average is formed from the sum of the points accumulated during the study year based on the totalizations scores and the individual work score.

Final: At the Exam to *Pharmacogenetics*, students with the average annual score below grade 5 are not admitted, as well as students who have not recovered absences from lectures and practical works.

The Exam in *Pharmacogenetics* (summative assessment) is made up of the oral test, which is done by including two questions in the tickets for the *Pharmacogenetics* and a Case Problem.

Final mark consists of two components: average annual mark (coefficient 0.5) and oral test (coefficient 0.5)

The roundup of the grades at the evaluation steps

INTERMEDIATE MARKS SCALE (annual average, marks from the examination stages)	National assessment system	ECTS Equivalent
1.00-3.00	2	F
3.01-4.99	4	FX
5.00	5	E
5.01-5.50	5.5	
5.51-6.0	6	
6.01-6.50	6.5	D
6.51-7.00	7	
7.01-7.50	7.5	C
7.51-8.00	8	
8.01-8.50	8.5	B
8.51-8.00	9	
9.01-9.50	9.5	A
9.51-10.0	10	

The average annual mark and the marks of all stages of final examination (computer assisted and oral test) - are expressed in numbers according to the mark scale (according to the table), and the final obtained mark is expressed in a number with two decimals, which is transferred to student's record-book.

Absence on examination without good reason is recorded as "absent" and equivalent to 0 (zero). The student has the right to have two re-examinations on failed subject.

XI. RECOMMENDED BIBLIOGRAPHY

A. Mandatory:

1. Katsung B.G. et al. Basic & Clinical Pharmacology In: *Pharmacogenetics*. 13th Edition, McGraw-Hill Education.2015
2. Bertino J.S., Jr, DeVane L.C., Fuhr U., Kashuba A., Ma J.D. Pharmacogenomics: An Introduction and Clinical Perspective. McGraw-Hill Education,.2013
3. Atkinson A.J., editors et al. Principles of Clinical Pharmacology. In: Clinical pharmacogenetics. 3rd Edition, Elsevier, 2012
4. Atkinson A.J., editors et al. Principles of Clinical Pharmacology - Pharmacogenomic mechanisms of drug toxicity. 3rd Edition, Elsevier, 2012.

B. Additional:

1. Brunton L.L., Chabner B.A., Knollmann B.C., editors: Goodman & Gilman's The Pharmacological Basis of Therapeutics, Pharmacogenetics. 12th Edition, 2011.
2. Webber W.W. Pharmacogenetics. Second Edition, Oxford University Press 2002.
3. McCullough K.B. Assessment of the pharmacogenomics educational needs of pharmacists. Am J Pharm Educ. 2011; 75(3):51.