



**INTEGRATED ACADEMIC STUDIES OF
PHARMACY**

SECOND YEAR OF STUDY

2024/2025.

PHARMACEUTICAL CHEMISTRY 1

Course:

PHARMACEUTICAL CHEMISTRY 1

The course is evaluated with 5 ECTS. There are 5 classes of active teaching per week (2 classes of lectures, 1 class of seminar and 2 classes of work in a small group)

TEACHING STAFF:

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	Name and surname	Email addresses	Title
1.	Miloš V. Nikolić	milos.nikolic@fmn.kg.ac.rs	Associate Professor - Course chief
2.	Nevena S. Jeremić	njeremic@fmn.kg.ac.rs	Associate Professor
3.	Marina Ž. Vesović	marina.vesovic@fmn.kg.ac.rs	Associate Professor
4.	Nikola V. Nedeljković	nikola.nedeljkovic@fmn.kg.ac.rs	Assistant Professor
5.	Ana S. Živanović	ana.zivanovic@fmn.kg.ac.rs	Assistant Professor

COURSE STRUCTURE:

Module	Name of module	Week	Lectures weekly	Seminars weekly	Work in small group	Teacher-module supervisor
1	Introduction to pharmaceutical chemistry and its importance. Strategies in drug design. Computer-aided design and detection of molecules. Relationship between functional groups and pharmacological activity of drugs. Membrane drug transporters. Receptors. Enzymes. Steroid hormones. Women's health. Men's health. Corticosteroids. Peptide hormones. Insulin and drugs for the regulation of diabetes. Thyroid function. Thyroid drugs. Calcium homeostasis. β -lactam antibiotics.	7	2	1	2	Nevena S. Jeremić
2	Aminoglycoside and macrolide antibiotics. Tetracyclines. Antibiotics of peptide and other structures. Sulfonamides. Quinolones and oxazolidinones. Antimycobacterial drugs. Antimycotics and antiparasitics. Antiseptics and disinfectants. Nutrition and obesity. Pharmaceutical chemistry of plants.	8	2	1	2	Miloš V. Nikolić

EVALUATION:

The student overcomes the subject by modules. The grade is equivalent to the number of points earned (see tables). Points are earned in two ways:

FINAL TESTS BY MODULES: According to the attached table, the student can gain up to 70 points this way. Following the demonstrated knowledge, the module test tasks are scored from 0 to 2 points, at 0.5 points each.

FINAL EXAM: According to the attached table, the student can earn up to 30 points this way. Based on the demonstrated knowledge, the tasks on the final exam were scored from 0 to 2 points, at 0.5 points each.

MODULE		MAXIMUM OF POINTS	
		Module test	Σ
1	Introduction to pharmaceutical chemistry and its importance. Strategies in drug design. Computer-aided design and detection of molecules. Relationship between functional groups and pharmacological activity of drugs. Membrane drug transporters. Receptors. Enzymes. Steroid hormones. Women's health. Men's health. Corticosteroids. Peptide hormones. Insulin and drugs for the regulation of diabetes. Thyroid function. Thyroid drugs. Calcium homeostasis. β-lactam antibiotics.	35 (minimum 18 points)	35
2	Aminoglycoside and macrolide antibiotics. Tetracyclines. Peptide antibiotics and antibiotics of other structures. Sulfonamides. Quinolones and oxazolidinones. Antimycobacterial drugs. Antimycotics and antiparasitics. Antiseptics and disinfectants. Nutrition and obesity. Pharmaceutical chemistry of plants.	35 (minimum 18 points)	35
FINAL EXAM		30 (minimum 15.5 points)	30
Σ			100

Note:

If the student did not pass the module activity during exercises he will pass it on the day of the exam. Only students who have previously passed all module activities and module tests can take the final exam.

The final grade is formed as follows:

To pass the course, the student has to obtain a minimum of 51 points and pass all modules as well as the final exam.

To pass the module the student has to:

1. obtain more than 50% points in that module
2. obtain more than 50% of the points predicted for the activity during exercises in each module
3. pass the module test, i.e. has more than 50% correct answers.

To pass the final exam, the student has to:

1. Obtain more than 50% points in that final exam

Number of points	Grade
0 - 50	5
51 - 60	6
61 - 70	7
71 - 80	8
81 - 90	9
91 - 100	10

TESTS BY MODULES

MODULE 1.

FINAL TEST of module 1

EVALUATION OF THE MODULE TEST

Each question is scored 0-2 points

MODULE 2.

FINAL TEST of module 2

EVALUATION OF THE MODULE TEST

Each question is scored 0-2 points

LITERATURE:

Module	Module name	Textbook title	Authors	Publisher	Library
1	Introduction to pharmaceutical chemistry and its importance. Strategies in drug design. Computer-aided design and detection of molecules. Relationship between functional groups and pharmacological activity of drugs. Membrane drug transporters. Receptors. Enzymes. Steroid hormones. Women's health. Men's health. Corticosteroids. Peptide hormones. Insulin and drugs for the regulation of diabetes. Thyroid function. Thyroid drugs. Calcium homeostasis. β -lactam antibiotics.	Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry.	John M. Beale John H. Block	Lippincott Williams & Wilkins; 2011.	Yes
		Foye's Principles of Medicinal Chemistry	Thomas Lemke	Wolters Kluwer. 2013.	Yes
		Pharmaceutical and medicinal chemistry.	David G. Watson	Churchill Livingstone; 2011.	Yes
2	Aminoglycoside and macrolide antibiotics. Tetracyclines. Peptide antibiotics and antibiotics of other structures. Sulfonamides. Quinolones and oxazolidinones. Antimycobacterial drugs. Antimycotics and antiparasitics. Antiseptics and disinfectants. Nutrition and obesity. Pharmaceutical chemistry of plants.	Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry	John M. Beale John H. Block	Lippincott Williams & Wilkins; 2011.	Yes
		Foye's Principles of Medicinal Chemistry	Thomas Lemke	Wolters Kluwer. 2013	Yes
		Pharmaceutical and medicinal chemistry	David G. Watson	Churchill Livingstone; 2011.	Yes

All lectures can be found on the website of the Faculty of Medicine: www.medf.kg.ac.rs

THE PROGRAM

FIRST MODULE: Introduction to pharmaceutical chemistry and its importance. Strategies in drug design. Computer-aided design and detection of molecules. Relationship between functional groups and pharmacological activity of drugs. Membrane drug transporters. Receptors. Enzymes. Steroid hormones. Women's health. Men's health. Corticosteroids. Peptide hormones. Insulin and drugs for the regulation of diabetes. Thyroid function. Thyroid drugs. Calcium homeostasis. β -lactam antibiotics.

TEACHING UNIT 1 (FIRST WEEK):

INTRODUCTION TO PHARMACEUTICAL CHEMISTRY AND ITS IMPORTANCE. RELATIONSHIP BETWEEN FUNCTIONAL GROUPS AND PHARMACOLOGICAL ACTIVITY OF DRUGS. STRATEGIES IN DRUG DESIGN.

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Introduction to pharmaceutical chemistry and its importance
 - Strategies in drug design
 - Computer-aided design and detection of molecules
 - Relationship between functional groups and pharmacological activity of drugs
 - General overview of the most important functional groups
 - pH values of body fluids
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TEACHING UNIT 2 (SECOND WEEK):

MEMBRANE DRUG TRANSPORTERS. RECEPTORS. ENZYMES.

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Types of membrane transporters
 - Receptors.
 - Covalent and ionic bonding
 - Hydrophobic interactions
 - Hydrogen bonding
 - The role of conformational changes
 - The role of stereochemistry
 - The most important classes of receptors
 - Enzymes
 - Reversible and irreversible enzyme inhibition
 - Antimetabolites
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TEACHING UNIT 3 (THIRD WEEK):

STEROID HORMONES. WOMEN'S HEALTH.

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Nomenclature of steroids (steroidal hydrocarbons)
 - Steroid hormones (biosynthesis of steroid hormones)
 - Female sex hormones
 - Aromatase inhibitors
 - Sterility therapy
 - Progesterone antagonists
 - Progestins
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TEACHING UNIT 4 (FOURTH WEEK):**MEN'S HEALTH. CORTICOSTEROIDS.**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
<ul style="list-style-type: none">• Male sex hormones• Biosynthesis of androgens• Androgen metabolism• Steroidal androgens• Non-steroidal androgens• Anabolics• Antiandrogens• Medicines in the therapy of erectile dysfunction• Corticosteroids (connection between structure and action, structural modifications, oxidation and reduction reactions)• Adrenocorticosteroids		

TEACHING UNIT 5 (FIFTH WEEK):**PEPTIDE HORMONES. ANTIHYPERGLYCEMICS AND THYROSTATICS.**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
<ul style="list-style-type: none">• Peptide hormones and synthetic analogues• Hypothalamic hormones• Pituitary hormones• Placental hormones• Pancreatic hormones• Biguanidine derivatives• Sulphonylurea derivatives• Newer sulfonamides and carboxamide derivatives• Thiazolidinedione derivatives• Artificial sweeteners• Peptide hormones in calcium homeostasis• Thyroid hormones (connection between structure and action, thyrostatics)		

TEACHING UNIT 6 (SIXTH WEEK): **β -LACTAM ANTIBIOTICS (FIRST PART).**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
<ul style="list-style-type: none">• β-lactam antibiotics• Penicillins• β-lactamase inhibitors		

TEACHING UNIT 7 (SEVENTH WEEK): **β -LACTAM ANTIBIOTICS (SECOND PART).**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
<ul style="list-style-type: none">• Cephalosporins• Carbapenem and monobactam antibiotic derivatives		

SECOND MODULE: Aminoglycoside and macrolide antibiotics. Tetracyclines. Peptide antibiotics and antibiotics of other structures. Sulfonamides. Quinolones and oxazolidinones. Antimycobacterial drugs. Antimycotics and antiparasitics. Antiseptics and disinfectants. Nutrition and obesity. Pharmaceutical chemistry of plants.

TEACHING UNIT 8 (EIGHTH WEEK):

AMINOGLYCOSIDE AND MACROLIDE ANTIBIOTICS.

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
<ul style="list-style-type: none"> • 2-deoxystreptamine derivatives • 4,6-disubstituted aminoglycosides of 2-deoxystreptamine • 4,5-disubstituted aminoglycosides of 2-deoxystreptamine • Chemical structure and properties of erythromycin • Semi-synthetic analogues of erythromycin A • Lincosamides • Polyene macrolides 		

TEACHING UNIT 9 (NINTH WEEK):

TETRACYCLINES. PEPTIDE ANTIBIOTICS AND ANTIBIOTICS OF OTHER STRUCTURES.

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
<ul style="list-style-type: none"> • General structure of tetracycline • Chemical properties and stability of tetracycline • Relationship between structure and antimicrobial activity of tetracycline • Mechanism of action • Natural tetracyclines • Semi-synthetic tetracyclines • Anthracyclines • Newer anthracyclines • Mitomycins • Antibiotics with a peptide structure • Bleomycins • Streptoins • Chloramphenicol • Antibiotics of different structure 		

TEACHING UNIT 10 (TENTH WEEK):

SULFONAMIDES. QUINOLONES AND OXAZOLIDINONES.

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
<ul style="list-style-type: none"> • Chemical properties of sulfonamides • Mechanism of action • Resorption and biotransformation • Relationship between chemical properties and biological activity • Fluoroquinolones • Relationship between structure and action • Basic chemical properties of quinolones • Mechanism of action • Antibacterial activity • Oxazolidinones 		

TEACHING UNIT 11 (ELEVENTH WEEK):**ANTIMYCOBACTERIAL DRUGS.**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Antimycobacterial drugs

TEACHING UNIT 12 (ELEVENTH WEEK):**ANTIMYCOTICS AND ANTIPARASITICS.**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Antimycotics (azoles, allylamine derivatives, various structures)
- Antiprotozoans
- Anthelmintics
- Pediculocides, scabicides and insecticides

TEACHING UNIT 13 (THIRTEENTH WEEK)**ANTISEPTICS AND DISINFECTANTS.**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Alcohols, epoxides, and aldehydes
- Phenols
- Preservatives and antioxidants
- Organic oxidizing agents
- Organic halogen compounds
- Organic chlorine compounds
- Organic compounds of mercury
- Surfactants
- Diamidines and guanidine derivatives
- Organic colors
- Derivatives of 5-nitrofurfural
- Uroantiseptics

TEACHING UNIT 14 (FOURTEENTH WEEK)**NUTRITION AND OBESITY.**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Medicines in obesity therapy
- Micronutrients
- Macronutrients

TEACHING UNIT 15 (FIFTEENTH WEEK)**PHARMACEUTICAL CHEMISTRY OF PLANTS.**

Lectures: 2 classes	Seminar: 1 class	Exercises: 2 classes
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- Medicinally and clinically important plants
- Chemistry of clinically important plants

SCHEDULE OF LECTURES & PRACTICE

THURSDAY

12.15-16.00

Hall at the
pediatric clinic

LESSON SCHEDULE FOR THE COURSE PHARMACEUTICAL CHEMISTRY 1

module	week	type	name of the teaching unit	teacher
1	1	L	Introduction to pharmaceutical chemistry and its importance. relationship between functional groups and pharmacological activity of drugs. strategies in drug design.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	1	S	Introduction to pharmaceutical chemistry and its importance. relationship between functional groups and pharmacological activity of drugs. strategies in drug design.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	1	E	Introduction with the most important tools in drug design.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	2	L	Membrane drug transporters. Receptors. Enzymes.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	2	S	Membrane drug transporters. Receptors. Enzymes.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	2	E	Introduction with the most important tools in drug design.	Nevena Jeremić Miloš Nikolić Marina Vesović Ana Živanović Nikola Nedeljković
	3	L	Steroid hormones. Women's health.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	3	S	Steroid hormones. Women's health.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović

LESSON SCHEDULE FOR THE COURSE PHARMACEUTICAL CHEMISTRY 1

module	week	type	name of the teaching unit	teacher
	3	E	Molecular modeling of drugs with steroid structure.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	4	L	Men's health. Corticosteroids.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	4	S	Men's health. Corticosteroids.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
1	4	E	Molecular modeling of the corticosteroid drugs.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	5	L	Peptide hormones. antihyperglycemics and thyrostatics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	5	S	Peptide hormones. antihyperglycemics and thyrostatics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	5	E	Molecular modeling of drugs with peptide structure.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	6	L	β -lactam antibiotics (first part)	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović

LESSON SCHEDULE FOR THE COURSE PHARMACEUTICAL CHEMISTRY 1

module	week	type	name of the teaching unit	teacher
	6	S	β -lactam antibiotics (first part)	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	6	E	Molecular modeling of the β -lactam antibiotics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	7	L	β -lactam antibiotics (second part)	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	7	S	β -lactam antibiotics (second part)	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	7	E	Molecular modeling of the β -lactam antibiotics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
		FTM	FINAL TEST OF MODULE 1	
2	8	L	Aminoglycoside and macrolide antibiotics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	8	S	Aminoglycoside and macrolide antibiotics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović

LESSON SCHEDULE FOR THE COURSE PHARMACEUTICAL CHEMISTRY 1

module	week	type	name of the teaching unit	teacher
	8	E	Molecular modeling of aminoglycosides and macrolides.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	9	L	Tetracyclines. Peptide antibiotics and antibiotics of other structures.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	9	S	Tetracyclines. Peptide antibiotics and antibiotics of other structures.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	9	E	Molecular modeling of tetracyclines and peptide antibiotics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	10	L	Sulfonamides. Quinolones and oxazolidinones.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	10	S	Sulfonamides. Quinolones and oxazolidinones.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	10	E	Molecular modeling of sulfonamides and quinolones.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	11	L	Antimycobacterial drugs.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović

LESSON SCHEDULE FOR THE COURSE PHARMACEUTICAL CHEMISTRY 1

module	week	type	name of the teaching unit	teacher
	11	S	Antimycobacterial drugs.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
2	11	E	Molecular modeling of antimycobacterial drugs.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	12	L	Antimycotics and antiparasitics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	12	S	Antimycotics and antiparasitics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	12	E	Molecular modeling of antiparasitic and antimycotic drugs.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	13	L	Antiseptics and disinfectants.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	13	S	Antiseptics and disinfectants.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	13	E	Molecular modeling of antiseptics.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović

LESSON SCHEDULE FOR THE COURSE PHARMACEUTICAL CHEMISTRY 1

module	week	type	name of the teaching unit	teacher
	14	L	Nutrition and obesity.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	14	S	Nutrition and obesity.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	14	E	Molecular modeling of obesity treatment drugs.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	15	L	Pharmaceutical chemistry of plants.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
2	15	S	Pharmaceutical chemistry of plants.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
	15	E	Molecular modeling of cardiotonic glycosides.	Nevena Jeremić Miloš Nikolić Marina Vesović Nikola Nedeljković Ana Živanović
		FTM	FINAL TEST OF MODULE 2	
		FE	FINAL EXAM	