COURSE UNIT DESCRIPTION

Course unit title	Code
Chromatography	

Annotation
Chromatography has been the technique of choice for many years to assess the chemical purity of drug substances and products and is widely used in the pharmaceutical industry, from research and development to quality control. This course examines in detail the theory of chromatographic methods used in pharmaceutical industry. The laboratory work develops the ability to select the most appropriate methods for the separation, identification and quantification of target analytes.

Lecturer(s)	Department, Faculty
Coordinating: dr. Vilius Poškus **Other:**	Faculty of Chemistry and Geosciences, Institute of Chemistry Naugardukas str. 24, LT-03225 Vilnius

Study cycle	Type of the course unit
Second	Mandatory

Mode of delivery	Semester or period when it is delivered	Language of instruction
Face to face	I semester	Lithuanian/English

Requisites	
Prerequisites: Main courses of analytical chemistry, inorganic chemistry, organic chemistry, polymer chemistry, physical chemistry and biochemistry.	**Co-requisites (if relevant):**

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5	135	64	71

Purpose of the course unit: programme competences to be developed		
The purpose of the course is to develop: ● knowledge and understanding in chromatographic techniques and their application in Pharma industry; ● ability to perform research work related to chromatographic analysis of pharmaceuticals; ● critical and analytical thinking.		
Learning outcomes of the course unit	**Teaching and learning methods**	**Assessment methods**
Students will be able to analyze, systematize and critically evaluate scientific information related to modern chromatographic techniques.	Lectures, literature review presentations, laboratory works and textbook reading.	Intermediate assessment. Assessment of presentation. All laboratory works must be done, laboratory reports must be compiled. Safe work in the laboratory. Final exam.
Students will be able to work in chemical laboratory safely.		
Students will be able to understand and explain the working principles of chromatographic techniques.		

Students will be able to choose the optimal chromatographic technique for separation, identification and quantification of pharmaceuticals.		
Students will be able to plan and competently perform analysis of pharmaceuticals using modern chromatographic techniques.		
Students will be able to analyze and evaluate the data obtained by chromatographic techniques.		

Course content: breakdown of the topics	**Contact hours**							**Individual work: time and assignments**	
	Lectures	Tutorials	Seminars	Workshops	Laboratory work	Internship/work placement	**Contact hours, total**	**Individual work**	**Assignments**
1. Introduction. Theoretical background. Classification of chromatographic methods. Intermolecular forces. Main characteristics: retention, efficiency, resolution, selectivity. Diffusion processes. Overloading effects.	4						**4**	**6**	Textbook reading.
2. Gas chromatography. Instrumentation. Packed and capillary columns. Stationary phases. Temperature programming modes.	2				8		**10**	**12**	Textbook reading. Getting ready for laboratory work. Preparation of laboratory work report.
3. Thin layer chromatography. Theory. Instrumentation. Stationary phases. Solvents. Detection techniques.	2						**2**	**5**	Textbook reading.
4. High performance liquid chromatography. Instrumentation. Stationary phases. Solvents. Separation modes: normal and reversed phase, hydrophilic interaction, ion-exchange, ion-pairing, size exclusion, affinity.	8				8		**16**	**12**	Textbook reading. Getting ready for laboratory work. Preparation of laboratory work report.
5. Chiral liquid chromatography. Chiral recognition mechanisms. Indirect and direct separation modes. Chiral selectors. Chiral stationary phases.	6						**6**	**6**	Textbook reading.
6. Capillary electrophoresis. Theory. Instrumentation. Capillary zone electrophoresis. Micellar electrokinetic chromatography. Capillary gel electrophoresis.	4						**4**	**4**	Textbook reading.
7. Preparation of pharmaceutical samples. Solvent extraction. Solid phase extraction. Supercritical fluid extraction. Derivatization. Column switching techniques.	4				8		**12**	**14**	Textbook reading. Getting ready for laboratory work. Preparation of laboratory work report. Getting ready for presentation.
8. Practical considerations. Column selection and testing. Mobile phase selection. System suitability	2				8		**10**	**12**	Textbook reading. Getting ready for

testing. Calibration and quantification. Determination of impurities.									laboratory work. Preparation of laboratory work report.
Total	**32**				**32**		**64**	**71**	

Assessment strategy	Weight %	Deadline	Assessment criteria
Laboratory work	10	Every week	Safe work in the laboratory. Ability to get reliable results. All laboratory works must be done, laboratory reports must be compiled (max. mark 10).
Intermediate assessment	15	Once in semester (under notice)	The test consists of 5-7 questions. The evaluation of the questions ranges from 0.5 to 1.5 points. The maximum score for test is 10 points, which is 15 percent of final evaluation.
Literature review	10	Presentation during semester	Problem statement, coverage of content, critical analysis, clarity of writing, references (max. mark 10).
Final exam	65	During the session	Open answer questions (10 in total. The evaluation of the questions ranges from 0.5 to 1.5 points. Max. mark. 10).

Author	Publishing year	Title	Issue of a periodical or volume of a publication; pages	Publishing house or internet site
Required reading				
A.Maruška, O.Kornyšova, E.Machtejevas	2005	Efektyviosios skysčių chromatografijos pagrindai		Kaunas, VDU leidykla.
S. Ahuja, M. W. Dong (Eds)	2005	Handbook of Pharmaceutical Analysis by HPLC		London, Elsevier
V. R. Meyer	2010	Practical High-Performance Liquid Chromatography	5th edition	John Wiley & Sons
Recommended reading				
L. R. Snyder, J. J. Kirkland, J. W. Dolan	2010	Introduction to Modern Liquid Chromatography, 3ed edition		New Jersey, John Wiley & Sons
D. G. Watson	2017	Pharmaceutical Analysis, 4th edition		Edinburgh, Elsevier
P. W. Carr, D. R. Stoll	2015	Two-Dimensional Liquid Chromatography Principles, Practical Implementation and Applications		Germany, Agilent Technologies