COURSE UNIT DESCRIPTION

Course unit title	
Organic Chemistry II	

Lecturer(s)	Department
Rimantas Vaitkus	Dept. Organic Chemistry, Vilnius University

Cycle	Type of the course unit
First	

Mode of delivery	Period of delivery	Language of instruction
Face to face		English

Prerequisites and co-requisites
General chemistry (prerequisites), Organic chemistry I (prerequisites).

Number of credits	Student's total workload	Contact hours	Self-study hours
10	250	64	186

Programme Learning Outcomes to be developed.
A1. will apply appropriate terminology, nomenclature, units of measurement used in describing chemical substances and their structure. A3. will characterise the main reactions of inorganic, organic and biologically active substances. A7. will be able to explain physical phenomena and apply them for the examination of chemical substances. B3. will choose and compare the most appropriate materials and reaction conditions to achieve a specific goal B5. will synthesize materials using common methods; will describe various methods of synthesis. B6. will work with chemicals safely. B8. will be able to conduct standard laboratory procedures and use laboratory equipment. C1. will apply theoretical knowledge in solving quantitative and qualitative problems of both familiar and unfamiliar nature. C2. will plan problem-solving strategies. C3. will evaluate and mathematically process the data. D4. will acquire skills for self-development, study skills in order to study both chemistry and general literature on the world outlook.

Learning outcomes of the course unit	Teaching and learning methods	Assessment methods

After successful completion of this course student should be able to: • Draw Lewis structures of organic compounds and calculate formal charges; • Draw possible resonance structures for neutral and charged organic species. Draw resonance hybride structures. • Identify functional groups in organic molecules; • Predict the polarity, solubility and other physical properties of organic molecules; • Predict the geometry of organic molecules; • Name organic compounds; • Draw step-by-step reaction mechanisms for most of organic reactions; • Assess the stability of reactive intermediates; • Explain the stereochemical outcome of organic reactions; • Explain the regioselectivity of organic reactions; • Identify nucleophilic and electrophilic atoms in organic molecules and predict their reactivity; • Write the reaction mechanisms using the notation of electron pair movement; •	Lectures. Individual problem solving; Problem solving classes (tutorials); Textbook reading.	Final exam (writing chemical reactions and their mechanism, rational explanation of the reaction outcome based on the reaction mechanism, identification of product's stereochemistry).

Topics	**Contact work hours**						**Time and tasks of self-study**	
	Lectures	Consultations	Seminars	Tutorials	Laboratory work	Total contact hours	Self-study	**Tasks**
1. **Introduction to Carbonyl Chemistry** (Organometallic Reagents; Oxidation and Reduction). Introduction. General Reactions of Carbonyl Compounds. A Preview of Oxidation and Reduction. Reduction of Aldehydes and Ketones. The Stereochemistry of Carbonyl Reduction. Reduction of Carboxylic Acids and Their Derivatives. Oxidation of Aldehydes. Organometallic Reagents. Reaction of Organometallic Reagents with Aldehydes and Ketones.	3			2				Textbook reading. Problem solving.

Retrosynthetic Analysis of Grignard Products. Protecting Groups (acetal protecting group). Reaction of Organometallic Reagents with Carboxylic Acid Derivatives. Reaction of Organometallic Reagents with Other Compounds. α,β-Unsaturated Carbonyl Compounds.								
2. **Aldehydes and Ketones—Nucleophilic Addition**. Introduction. Nomenclature. Physical Properties. Interesting Aldehydes and Ketones. Preparation of Aldehydes and Ketones. Reactions of Aldehydes and Ketones—General Considerations. Nucleophilic Addition of H– and R. Nucleophilic Addition of –CN. The Wittig Reaction. Addition of 1° Amines. Addition of 2° Amines. Addition of H_2O—Hydration. Addition of Alcohols—Acetal Formation. Acetals as Protecting Groups. Cyclic Hemiacetals	4			4				Textbook reading. Problem solving.
3. **Carboxylic Acids and Their Derivatives** (Nucleophilic Acyl Substitution). Introduction. Structure and Bonding. Nomenclature Physical Properties. Interesting Esters and Amides. Introduction to Nucleophilic Acyl Substitution. Reactions of Acid Chlorides. Reactions of Anhydrides. Reactions of Carboxylic Acids. Reactions of Esters. Application: Lipid Hydrolysis. Reactions of Amides. Application: The Mechanism of Action of β-Lactam Antibiotics. Natural and Synthetic Fibers. Biological Acylation Reactions.	3			4				Textbook reading. Problem solving.

Nitriles								
4. **Substitution Reactions of Carbonyl Compounds at α-carbon Atom**. Introduction. Enols. Enolates. Enolates of Unsymmetrical Carbonyl Compounds. Racemization at the α Carbon. A Preview of Reactions at the α Carbon. Halogenation at the α Carbon. Direct Enolate Alkylation. Malonic Ester Synthesis. Acetoacetic Ester Synthesis	4			4				Textbook reading. Problem solving.
5. **Carbonyl Condensation Reactions**. The Aldol Reaction. Crossed Aldol Reactions. Directed Aldol Reactions. Intramolecular Aldol Reactions. The Claisen Reaction. The Crossed Claisen and Related Reactions. The Dieckmann Reaction. The Michael Reaction. The Robinson Annulation	4			4				Textbook reading. Problem solving.
6. **Carbohydrates** Introduction. Monosaccharides. The Family of D-Aldoses. The Family of D-Ketoses. Physical Properties of Monosaccharides. The Cyclic Forms of Monosaccharides. Glycosides. Reactions of Monosaccharides at the OH Groups. Reactions at the Carbonyl Group—Oxidation and Reduction. Reactions at the Carbonyl Group—Adding or Removing One CarbonAtom. The Fischer Proof of the Structure of Glucose. Disaccharides. Polysaccharides. Other Important Sugars and Their Derivatives	4			4				Textbook reading. Problem solving.

7. **Amines**. Introduction. Structure and Bonding. Nomenclature. Physical Properties. Interesting and Useful Amines. Preparation of Amines. Reactions of Amines— General Features. Amines as Bases. Relative Basicity of Amines and Other Compounds. Amines as Nucleophiles. Hofmann Elimination. Reaction of Amines with Nitrous Acid. Substitution Reactions of Aryl Diazonium Salts. Coupling Reactions of Aryl Diazonium Salts. Application: Synthetic Dyes	4			4				Textbook reading. Problem solving.
8. **Amino Acids and Proteins**. Amino Acids. Synthesis of Amino Acids. Separation of Amino Acids. Peptides. Peptide Sequencing. Peptide Synthesis. Automated Peptide Synthesis. Protein Structure	2			2				Textbook reading. Problem solving.
9. **Introduction to Heterocycles**. Pyridine, Pyrrole, Thiophene, Furan. Synthesis of Heterocycles. Structure, bonding and properties. Electrophilic Substitution Reactions	4			4				Textbook reading. Problem solving.
Total	**32**			**32**				

Assesment strategy	**Weight %**	**Assessment period**	**Assessment criteria**
Final Exam	100 %	January	Open answer questions

Reading list

Author	**Year of publ.**	**Title**	**Publisher**	**Number of volumes in the library of faculty**
Main reading list				
T. W. G. Solomons, C. B. Fryhle	2000, 2004, 2008	Organic Chemistry	Wiley	71
J. McMurry	2003 2004	Organic Chemistry	Brooks/Cole	16
Additional reading list				

J. Clayden, N. Greeves, S. Warren, P. Wothers	2007	Organic Chemistry)	Oxford University Press	14