GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | , PG_00066638 | | |
| Field of study | Recycling and Energy Recovery | | |
| Date of commencement of studies | October 2024 | Academic year of realisation of subject | 2024/2025 |
| Education level | first-cycle studies | Subject group | |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 1 | Language of instruction | Polish |
| Semester of study | 2 | ECTS credits | 3.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Department of Organic Chemistry -> Faculty of Chemistry | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. Sławomir Makowiec | |
| | Teachers | dr hab. Sławomir Makowiec<br>dr inż. Monika Gensicka-Kowalewska<br>dr inż. Karolina Kucharska<br>dr inż. Agata Sommer<br>dr hab. inż. Hanna Staroszczyk | |

Lesson types and methods of instruction

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 20.0 | 0.0 | 20.0 | 0.0 | 0.0 | 40 |

E-learning hours included: 0.0

Learning activity and number of study hours

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 40 | 0.0 | 0.0 | 40 |

Subject objectives

The student acquires basic knowledge and skills in organic chemistry. Learning the chemical and physical properties of basic groups of organic compounds. Learning examples of practical use of knowledge about the reactivity of organic compounds in the context of the synthesis of fuel additives, biomass processing, and polymer modification.

Learning outcomes

| Course outcome | Subject outcome | Method of verification |
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| [K6_U02] solves engineering issues and problems in the area of raw materials and energy recovery through the use of appropriate analytical, numerical and experimental tools and methods. | The student is able to carry out a simple physical or chemical process of separating mixtures of organic compounds into individual components. | [SU3] Assessment of ability to use knowledge gained from the subject<br>[SU2] Assessment of ability to analyse information |
| [K6_U01] applies knowledge of mathematics and other exact sciences and engineering disciplines to solve theoretical, engineering and technological problems and issues. | The student is able to determine the basic physicochemical properties of a compound based on its structure. | [SU2] Assessment of ability to analyse information<br>[SU3] Assessment of ability to use knowledge gained from the subject |
| [K6_W02] analyzes engineering and technological issues and problems in the area of raw materials and energy recovery using appropriate and appropriate analytical, numerical and experimental tools and methods | The student knows what methods of separating mixtures of organic compounds to use depending on their chemical and physical properties. | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |
| [K6_W01] demonstrates knowledge and understanding of mathematics and other exact sciences and engineering disciplines at the level necessary to solve theoretical, engineering and technological problems and issues. | The student knows what reactions the main groups of organic compounds undergo.<br>The student knows what physicochemical properties have the main groups of organic compounds. | [SW3] Assessment of knowledge contained in written work and projects<br>[SW1] Assessment of factual knowledge |

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| Subject contents | Lecture topics1 Introduction to coal chemistry. Structural formulas - ways of writing the structure of molecules. Isomerism of organic compounds. Alkanes, alkenes, alkynes, aromatic hydrocarbons, reactivity, chemical and physical properties, methods of preparation and purification. Acids, bases, electrophiles, nucleophiles, radicals - brief characteristics.2 Alcohols, phenols and ethers. Preparation, reactivity, physical properties. The use of alcohols and ethers as fuel additives. Chemical basis of the process of increasing the octane number of gasoline.3 Carbonyl compounds: ketones, aldehydes, carboxylic acids, esters and amides. Synthetic methods of production and natural sources. Reactivity and physical properties. Chemistry of the biodiesel production process.4 Organic compounds containing nitrogen: amines, nitriles, amides, amino acids, ureas, isocyanates. Reactivity and preparation methods. Heterocyclic compounds structure and physicochemical properties.5 Synthetic polymers. Polymer structure and physical properties. Ways to receive. Monomer synthesis methods. Polymerization and polycondensation. Depolymerization reactions. Polymer degradation6. Natural polymers. Cellulose, starch, glycogen, proteins. Structure and the resulting chemical and physical properties. Methods of modifying natural polymers.7. Decomposition processes of natural polymers. Natural polymers as a component of biomass for energy purposes.8. Biomass conversion processes. Biofuel generations. Liquid and gaseous biofuels from biomass.9. Biochemical conversion of biomass. Photolysis, anaerobic digestion, dark fermentation and photofermentation.10. Thermochemical conversion of biomass. Gasification, hydrothermal liquefaction, pyrolysis, carbonization.11. Biohydrogen and biogas. Composition of liquid and gaseous streams in the processes of producing liquid and gaseous biofuels. Chemical transformations of by-products in the liquid phase. Biorefining.Topics of laboratory classesA Separation of multi-component mixtures1 Separation of a multi-component mixture containing acidic, basic and neutral compounds. Preparation of solutions needed for extraction. Pre-filtration of insoluble ingredients. The use of extraction to separate a mixture into groups of substances: acidic, basic, neutral.2 Carrying out distillation at atmospheric pressure of the components of the neutral fraction previously obtained from the extraction. Crystallization of products obtained from the basic fraction.3 Carrying out vacuum distillation of the components of the acid fraction previously obtained from extraction.B Obtaining biodiesel from used frying fatsThe aim of this laboratory exercise is to familiarize students with the process of producing biodiesel from frying fats, which are waste from the food industry. Students will gain practical knowledge about the conversion of fats to fatty acid esters and understand the importance of alternative energy sources in the context of sustainable development.C. Conversion of waste biomass to gaseous biofuels.The aim of the laboratory exercise is to familiarize students with unit operations used during pre-treatment, hydrolysis and fermentation of biomass. Students will gain practical knowledge about the conversion of biomass into biohydrogen/biogas/bioethanol and become familiar with statistical and analytical tools for optimizing the processes. |
| Prerequisites and co-requisites | Knowledge of basic chemical laws and concepts.Knowledge of basic physical laws and concepts. |
| Assessment methods and criteria | |

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| | 60.0% | 20.0% |
| | 60.0% | 20.0% |
| | 60.0% | 40.0% |
| | 60.0% | 20.0% |

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|---|---|---|
| Recommended reading | Basic literature | Robert Thornton Morrison , John Boyd - Chemia Organiczna Tom 1,2,3 PWN 2011<br><br>John McMurry - Chemia Organiczna Tom 1,2,3 PWN 2000 |
| | Supplementary literature | Przemysław Mastalerz - Chemia Organiczna PWN 1986 |
| | eResources addresses | Adresy na platformie eNauczanie:<br>Podstawy chemii nieorganicznej i organicznej - Moodle ID: 45250<br>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=45250 |
| Example issues/ example questions/ tasks being completed | | |
| Work placement | Not applicable | |

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