

## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                         |                                     |                        |            |     |
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| Subject name and code                       | Antioxidants - science, health and business, PG_00015988                                                                                                                                                                                                                                                                                                     |                                                          |                                         |                                     |                        |            |     |
| Field of study                              | Chemical Business                                                                                                                                                                                                                                                                                                                                            |                                                          |                                         |                                     |                        |            |     |
| Date of commencement of studies             | October 2026                                                                                                                                                                                                                                                                                                                                                 |                                                          | Academic year of realisation of subject |                                     | 2028/2029              |            |     |
| Education level                             | Bachelor's studies                                                                                                                                                                                                                                                                                                                                           |                                                          | Subject group                           |                                     | Optional subject group |            |     |
| Mode of study                               | full-time studies                                                                                                                                                                                                                                                                                                                                            |                                                          | Mode of delivery                        |                                     | at the university      |            |     |
| Year of study                               | 3                                                                                                                                                                                                                                                                                                                                                            |                                                          | Language of instruction                 |                                     | Polish                 |            |     |
| Semester of study                           | 6                                                                                                                                                                                                                                                                                                                                                            |                                                          | ECTS credits                            |                                     | 1.0                    |            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                                                                                                     |                                                          | Assessment form                         |                                     | credit                 |            |     |
| Conducting unit                             | Laboratory of Catalytic Materials and Processes -> Department of Environmental Technology -> Faculty of Chemistry -> Rector                                                                                                                                                                                                                                  |                                                          |                                         |                                     |                        |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                                                                                           |                                                          | dr Joanna Drzeżdżon                     |                                     |                        |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                                                                                                     |                                                          | dr Joanna Drzeżdżon                     |                                     |                        |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                                                                                                  | Lecture                                                  | Tutorial                                | Laboratory                          | Project                | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                                                                                        | 15.0                                                     | 0.0                                     | 0.0                                 | 0.0                    | 0.0        | 15  |
|                                             | 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                                                                                                                                                                                                                                                                                                                                        | 15                                                       |                                         | 2.0                                 |                        | 8.0        | 25  |
| Subject objectives                          | To familiarize students with: the definition of antioxidants and their role in the body and their effect on human health, with the phenomenon of oxidative stress of oxidative stress, the causes of its formation and mechanisms to counteract antioxidative stress, environmental problems, with the application of antioxidants in medicine and industry. |                                                          |                                         |                                     |                        |            |     |

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| Learning outcomes               | Course outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Subject outcome                                                                                                                                                                           | Method of verification                                                                            |
|                                 | [BCHINŻ_K02] Works individually demonstrating initiative and independence in actions, and effectively cooperates in a team, performing various roles in it.                                                                                                                                                                                                                                                                                                                                            | The student independently prepares presentations and actively participates in teamwork when analysing cases or debating the controversy surrounding antioxidants and dietary supplements. | [SK8] observation of student's independent or team work                                           |
|                                 | [BCHINŻ_K04] Demonstrates responsibility for the safety of her/his own and others' work.                                                                                                                                                                                                                                                                                                                                                                                                               | The student identifies the risks associated with the use of antioxidants in different environments (laboratory, industry, food, cosmetics).                                               | [SK5] implementation of a problem task<br>[SK8] observation of student's independent or team work |
|                                 | [BCHINŻ_U01] On the basis of the acquired knowledge, identifies, analyses and solves engineering tasks and problems in broadly understood chemistry.                                                                                                                                                                                                                                                                                                                                                   | The student analyses the chemical composition of natural and synthetic antioxidants and proposes their use in health and industrial contexts.                                             | [SU1] oral statement/conversation/discussion                                                      |
|                                 | [BCHINŻ_W06] Enumerates basic unit processes and describes issues in the field of technology and chemical engineering.                                                                                                                                                                                                                                                                                                                                                                                 | The student describes the processes of extraction, synthesis and production of antioxidants in the context of the chemical and food industries.                                           | [SW4] test/exam - oral or written<br>[SW1] oral statement/conversation/discussion                 |
|                                 | [BCHINŻ_W02] Enumerates basic laws and theories in chemistry, physics and mathematics necessary to formulate and solve simple engineering tasks.                                                                                                                                                                                                                                                                                                                                                       | The student explains the mechanisms of action of antioxidants at the molecular and atomic level, referring to the principles of physical chemistry and organic chemistry.                 | [SW4] test/exam - oral or written<br>[SW1] oral statement/conversation/discussion                 |
| Subject contents                | [BCHINŻ_U08] Uses the chemical nomenclature and engineering terminology properly.                                                                                                                                                                                                                                                                                                                                                                                                                      | The student uses correct chemical nomenclature and specialised vocabulary in the context of the structure and uses of antioxidants and metabolic processes involving antioxidants.        | [SU1] oral statement/conversation/discussion<br>[SU4] test/exam - oral or written                 |
|                                 | Lecture topics: natural and synthetic antioxidants. Causes of free radicals. Oxidative stress. Complex compounds of transition metal ions as antioxidants. Free radicals in chemistry, biology and medicine. Oxidative stress and cancer cells. Dietary supplements with antioxidant properties. Chemical methods of determining antioxidant activity. The search for new compounds complexes of transition metal ions as potential antioxidants.                                                      |                                                                                                                                                                                           |                                                                                                   |
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| Prerequisites and co-requisites | - scope of knowledge - atomic structure and electron structure of multi-electron atom, molecule, types of bonds, intermolecular interactions. Periodic table and properties of multi-electron elements. Skills and competencies - description of chemical properties of elements and inorganic compounds; evaluation of bond strength and reactivity of inorganic compounds on the basis of their structure; understanding the mechanisms of intermolecular interactions in different states of matter |                                                                                                                                                                                           |                                                                                                   |
|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                           |                                                                                                   |
| Assessment methods and criteria | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Passing threshold                                                                                                                                                                         | Percentage of the final grade                                                                     |
|                                 | written test and open questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 51.0%                                                                                                                                                                                     | 100.0%                                                                                            |
| Recommended reading             | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                           |                                                                                                   |
|                                 | Bartosz G.: The Second Face of Oxygen, Wydawnictwo Naukowe PWN, Warsaw 2008. Le Cren F.: Antioxidants: a revolution in 21st century medicine, Warsaw 2006. Puzanowska-Tarasiewicz, H., Kuźmicka, L., Tarasiewicz, M. (2010). Antioxidants and reactive oxygen species. Bromat. Chem. Toxicol, 43(1), 9-14. Davies D.: Vitamin A, natural antioxidants and chemoprevention in cosmetic and reconstructive plastic surgery, Polish Journal of Cosmetology 2003/1.                                        |                                                                                                                                                                                           |                                                                                                   |

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|                                                                | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Kulbacka, J., Saczko, J., & Chwiłkowska, A. (2009). Oxidative stress in the processes of cell damage. Pol. Merc. Lek, 27(157), 44-47. Ball S.: Antioxidants in human medicine and health, Oficyna Wydawnicza Medyk, 2001. Sikora, M.: Antioxidants: protection for cosmetic preparation, fighting skin aging, Chemical Market 2005/7-8. |
|                                                                | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                         |
| Example issues/<br>example questions/<br>tasks being completed | <p>Classification of antioxidants - natural vs synthetic, water and fat soluble.</p> <p>Mechanisms of action of antioxidants - neutralisation of free radicals, redox reactions, chelation of metals.</p> <p>Importance of antioxidants in the human body - oxidative stress, neurodegenerative diseases, cancer.</p> <p>Antioxidants in food - role as food additives, shelf life extension.</p> <p>Antioxidants in cosmetology and pharmacy - ingredients in anti-aging creams, dietary supplements.</p> <p>Industrial production and extraction of antioxidants - methods of isolation from natural raw materials, chemical synthesis.</p> <p>Review of controversies and myths - excess antioxidants, side effects, marketing vs scientific facts.</p> <p>Sustainability and green chemistry - using plant waste as a source of antioxidants.</p> <p>Models for assessing antioxidant activity - DPPH, ABTS, FRAP tests, etc. Regulation and market for antioxidants - EFSA, FDA, safety of use, labelling.</p> |                                                                                                                                                                                                                                                                                                                                         |
| Work placement                                                 | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                         |

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