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| **Course code** | CC4 |
| **Type and description** | **CC** - Core Course |
| **ECTS credits** | 2 |
| **Course name** | **Advanced Molecular and Macromolecular Materials Science** |
| **Course name in Polish** | Zaawansowana Inżynieria Materiałów Molekularnych i Makromolekularnych |
| **Language of instruction** | English |
| **Course level** | 8 PRK |
| **Course coordinator** | prof. dr hab. Krzysztof Matyjaszewski / prof. dr hab. Wojciech Pisula |
| **Course instructors** | prof. dr hab. Krzysztof Matyjaszewski, prof. dr hab. Wojciech Pisula, dr hab. inż. Joanna Pietrasik, prof. dr hab. Jacek Ulański, dr hab. inż. Beata Łuszczyńska |
| **Delivery methods and course duration** | |  | **Lecture** | **Tutorials** | **Laboratory** | **Project** | **Seminar** | **Other** | **Total of teaching hours during semester** | | --- | --- | --- | --- | --- | --- | --- | --- | | Contact hours | 30 | 0 | 0 | 7 | 8 | 0 | 45 | | E-learning | No | No | No | No | No | No |  | | Assessment criteria (weightage) | 0.60 | 0.00 | 0.00 | 0.30 | 0.10 | 0.00 |  | |
| **Course objective** | The aim of the course is to enable students to acquire knowledge in the field of the relationship between the chemical and supramolecular structure and the properties of molecular and macromolecular materials.  In particular, problems of molecular materials and nanomaterials as well as macromolecular engineering will be discussed from the point of view of materials applications.  Students get acquainted with advanced methods of synthesis and processing of functional materials, such as, for example, reversible deactivation radical polymerizations, self-assembly, etc. |
| **Learning outcomes** | A PhD student after completing the course can:  1. characterize the relationship between structure and material properties - effects ***W1 P8S\_EG, U1 P8S\_UW***  2. describe the theoretical basis defining the properties of materials - effects ***W1 P8S\_EG, U1 P8S\_UW***  3. choose appropriate methods of synthesis and material processing - effects - ***W1 P8S\_EG, U1 P8S\_UW, K1 P8S\_KK*** |
| **Assessment methods** | Verification methods of learning outcomes  effects ***W1 P8S\_EG, U1 P8S\_UW, K1 P8S\_KK*** - written exam  effect ***W1 P8S\_EG, U1 P8S\_UW, K1 P8S\_KK*** - project preparation  effect ***K1 P8S\_KK*** - project presentation  The final grade consists of:  The result of the written exam - 60%  Result from the project evaluation - 30  Presentation - 10% |
| **Prerequisites** | none |
| **Course content with delivery methods** | LECTURE, part I  Introduction to the macromolecular engineering; living and controlled polymerization  The basic elements of controlled ion polymerization  Basics of controlled radical polymerization  Atom Transfer Radical Polymerization (ATRP))  ATRP - synthesis (catalysts and initiators)  Architectural control of macromolecules - topology (branched, comb-branched macromolecules)  Architecture control of macromolecules - composition of copolymers (statistical, block, gradient copolymers)  Architecture control of macromolecules - functionalization  Hybrid polymers with inorganic and biological elements  Applications and industrial products obtained by controlled polymerization methods  LECTURE, part II  Selected, current issues in chemistry and physics of organic solids (molecular crystals, liquid crystals, amorphous materials, polymers) and nanomaterials (nanoparticles, nanocomposites) organic, inorganic and hybrid and used in the field of nanotechnology.  Relations between the chemical structure and supramolecular structure, and properties of molecular materials and nanomaterials.  The role of self-organization in the production of molecular materials and nanomaterials with the desired supramolecular structure.  The possibilities of their applications in electronics, biology, environmental protection and medicine.  PROJECT  Designing the molecular structure of polymers with a specific target application.  Development of a methodology for the production of molecular materials and functional nanomaterials using advanced processing methods.  SEMINAR  Critical analysis of the literature related to the discussed research problems. |
| **Basic reference materials** | 1. Tutor’s materials.  2. A.H.E. Mueller, K. Matyjaszewski; eds.: Controlled and Living Polymerizations: From Mechanisms to Materials, Wiley-VCH, Weinheim, 2009.  3. T.P. Davis, K. Matyjaszewski eds.: Handbook of Radical Polymerization, Willey, 2002.  4. K. Matyjaszewski, Y. Gnanou, L. Leibler eds.: Macromolecular Engineering: Precise Synthesis, Materials Properties, Applications - Volume 1-4, Willey-VCH, 2007.  5. B. Łuszczyńska, K. Matyjaszewski, J. Ulański eds.: Solution processable components for organic electronics, Wiley VCH, 2019.  6. A.G. Davies, J.M.T. Thompson eds.: Advances in Nanoengineering, Imperial College Press, London 2007.  7. W. Jones: Organic Molecular Solids, Properties and Applications, CRC, New York.  8. H. Masuhara, H. Nakanishi, K. Sasaki eds.: Single Organic Nanoparticles, Springer, 2003.  9. V. Balzani, M. Venturi, A. Credi: Molecular Devices and Machines, Wiley-VCH, 2003.  10. J.W. Steed, J.L. Atwood: Supramolecular Chemistry, John Wiley & Sons, 2013. |
| **Other reference materials** | current scientific articles, given by the lecturer |
| **Average student workload outside classroom** | 20 hrs |
| **Comments** | - |
| **Last update** | 2019-04-12 |