GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Optimisation of Engineering Systems, PG_00042531 | | |
| Field of study | Environmental Engineering | | |
| Date of commencement of studies | October 2022 | Academic year of realisation of subject | 2022/2023 |
| Education level | second-cycle studies | Subject group | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |
| Mode of study | Part-time studies | Mode of delivery | at the university |
| Year of study | 1 | Language of instruction | Polish |
| Semester of study | 2 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Sanitary Engineering -> Faculty of Civil and Environmental Engineering | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Ryszard Orłowski | |
| | Teachers | dr inż. Ryszard Orłowski | |

| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
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| | Number of study hours | 20.0 | 0.0 | 10.0 | 0.0 | 0.0 | 30 |
| | 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 |
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| | Number of study hours | 30 | 5.0 | 65.0 | 100 |

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| Subject objectives | The purpose of the subject is familiarization students with modern methods of design of construction and control of engineering systems when taking into consideration not only some classical design limitations but also optimization and reliability criteria. The other purpose is familiarization students with some general trends of optimal solutions in the area of sanitary engineering systems - knowledge for possible direct utilization in engineering practice. |

| Learning outcomes | Course outcome | Subject outcome | Method of verification |
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| | [K7_W01] has broadened and deepened knowledge of selected mathematics sections, including statistics components and optimization methods, and mathematical and numerical methods necessary for: 1) modeling and analysis of water supply systems and their physical phenomena; 2) description and analysis of flood protection systems; 3) functional analysis, optimization and reliability of sanitary engineering systems; 4) description of phenomena related to the flow of water in the environment, in pipes and open channels, filtration, migration of pollutants | When a student is performing design studies concerning construction and control of water-industrial and sanitary engineering systems he is using the computer modeling (computer simulation), optimization, reliability and system analysis methods. | [SW2] Assessment of knowledge contained in presentation<br>[SW3] Assessment of knowledge contained in written work and projects |
| | [K7_W04] knows the basic automation methods, techniques, tools and systems used to solve complex engineering tasks in modeling, optimization and control of processes, objects and systems in environmental engineering | A student is designing systems of optimal regulation and control considering modern methods that are used currently in the area. | [SW2] Assessment of knowledge contained in presentation<br>[SW3] Assessment of knowledge contained in written work and projects |
| | [K7_U10] can, in accordance with scientific principles, use the scientific workshop to formulate and conduct preliminary research on the engineering, technological and organizational problems that arise in environmental engineering | Student solves questions from the range of reliability and optimization of system which require non-standard approach, among others in the range of some analytical and numerical methods applicable and formulating of optimization criteria as well as individual approach to the problem of the risk. | [SU3] Assessment of ability to use knowledge gained from the subject<br>[SU1] Assessment of task fulfilment<br>[SU4] Assessment of ability to use methods and tools |
| | [K7_U14] can technically and economically analyze and evaluate the solutions and functioning of facilities and systems in the sanitary engineering or flood protection, water intakes and water infrastructure or water and wastewater treatment plants; can assess the suitability and potential of using new achievements in materials, fixtures, devices and methodologies for designing and modeling the analyzed technical infrastructure and industrial objects, including innovative solutions | A student evaluates of possibility of using the solutions of innovative character, (in it are judging latest achievements in materials and devices) for optimal design of sewerage and water supply systems and the influence of the solutions on reliability of the systems. | [SU3] Assessment of ability to use knowledge gained from the subject<br>[SU1] Assessment of task fulfilment |
| | [K7_U13] can integrate knowledge in the areas of sanitary engineering, automatics, electronics, computer science, chemistry, biology and other disciplines in the formulation and solving tasks related to the design or modeling of sanitary systems and their components, using a systematic approach including non-technical aspects (including economic and legal) | When solving the problems of optimization of sanitary engineering systems he integrates knowledge from the domains of sanitary engineering, automation, electronics, informatics and other disciplines. He uses system approach with taking into consideration extratechnical aspects (such as economic and legal). | [SU3] Assessment of ability to use knowledge gained from the subject<br>[SU4] Assessment of ability to use methods and tools<br>[SU2] Assessment of ability to analyse information |

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| Subject contents | LECTURES: Introduction; types of mathematical problems solved by the engineers with respect to systems. Optimal design. Classification of well known mathematical methods used in optimization. Mathematical problem of the analysis type; illustration of the problem for a case of the system of water supply (case of existing system and optimum design a new system by means of analysis of some design variants). The problem of global optimization of sewage system; multilevel optimization solved by the method of decomposition and coordination. Solving the problem at some separate levels, detailed problems. The problem of global optimization of Water Transport and Distribution. System (WTDS); multilevel optimization solved by the method as above. Solving the problem at some separate levels, detailed problems. The problem of optimum, reliable, computer aided dispatcher control of WTDS software (computational models, databases, GIS), environment (telemetry, Internet access). The task of a comprehensive computer-aided dispatcher control of WTDS mode of conduct and diagrams using appropriate hardware and software. Basis of the reliability theory and its appliance for the design of some engineering systems such as sewage and water supply systems. Questions of optimization and reliability in the problems of design and system analysis of spacing and location of storm overflows in the sewage combined system. Reliability problems in design of exemplary objects in outdoor networks of municipal infrastructure (e.g. pump stations, some passages of roadblocks). Reliability problems in design of Installations in building engineering.<br>LABORATORY CLASSES: Solving practical problems from the area of optimization and reliability. The cases study are sanitary installation, sewage and water supply sustems. |
| Prerequisites and co-requisites | Passed the basic programs of water supply systems and sewage systems. Passed the basic programs of organization of engineering labour. Basic knowledge of numerical methods; general knowledge of methods of solvig of sets of nonlineary equations. |

Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
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| Participating in lectures and laboratory exercises | 60.0% | 30.0% |
| Written exam | 60.0% | 70.0% |

Recommended reading

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| Basic literature | 1.Kowalik P.: Optymalizacja systemów inżynierii sanitarnej. skrypt, Politechnika Gdańska, Gdańsk, 1988r.<br><br>2. Findeisen Wł.: Teoria i metody obliczeniowe optymalizacji. PWN, W-wa, 1980 r.<br><br>3. Praca zbiorowa (pod red. Wł. Findeisena): Analiza systemowa podstawy i metodologia. PWN, W-wa, 1980 r.<br><br>4. Biedugnis S., Miłaszewski R.: Metody optymalizacyjne w wodociągach i kanalizacji. PWN, W-wa, 1993r.<br><br>5. Biedugnis S., Cholewiński J.: Optymalizacja gospodarki odpadami. PWN, W-wa, 1992 r.<br><br>6. Wieczysty A.: Niezawodność systemów wodociągowo - kanalizacyjnych. skrypt, Politechnika Krakowska, Kraków, 1990 r. |
| Supplementary literature | Szymkiewicz R.: Metody numeryczne w inżynierii wodnej, Wydawnictwo Politechniki Gdańskiej, Gdańsk, 2007<br><br>JAN STUDZISKI, Instytut Badań Systemowych REINHARD STRAUBELREUS GmbH, Berlin **OPTYMALIZACJA I STEROWANIE MIEJSKIEJ SIECI WODOCIĄGOWEJ NA PODSTAWIE MODELI MATEMATYCZNYCH**<br><br>Sławczo DENCZEW **NIEZAWODNOŚĆ, BEZPIECZEŃSTWO I RYZYKO SYSTEMÓW EKSPLOATACJI WODOCIAGÓW W ASPEKCIE INFRASTRUKTURY KRY T YCZNEJ**<br><br>Roman MIELCAREK **OPTYMALIZACJA KOSZTÓW PRZEPOMPOWNI ŚCIEKÓW** |
| eResources addresses | Adresy na platformie eNauczanie: |

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| Example issues/ example questions/ tasks being completed | The problem of global optimization of sewerage system.<br><br>The problem of optimization of gravitational-pressure system of effluent transport.<br><br>The problem of global optimization of water transport and distribution system for water-supply; networks of different shapes.<br><br>Optimal and reliable, computer aided decision-maker control of the system of water transport and distribution. |
| Work placement | Not applicable |