

GDANSK UNIVERSITY OF TECHNOLOGY

FACULTY OF CIVIL AND
ENVIRONMENTAL ENGINEERING

**Full-time MSc Studies
in Environmental Engineering**

*Study programme
syllabus*



Code: GCEE01

STATISTICS

Field of study: Environmental Engineering						Responsible Persons: dr inż. Tomasz Kolarski
Postgraduate studies (MSc – course)						
Full-time studies						Department of Hydroengineering
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 3
	15	30				Assessment: test
<p>Topics: Overview of probability theory and statistics; Event (a subset of the sample space); Entropy of the set of events; Markov chain; Empirical distribution; Random variable; Basic distributions of the one-dimensional random variables; Multivariate normal distribution; Normal distribution – characterization, properties; Probability distributions of the meteorological and hydrological processes; Regression analysis; Linear and nonlinear regression; Correlation and dependence; Statistical population; Sample (a subset of a population); Confidence interval (CI); Estimation Theory (for topics involving inferences about probability distributions); Flow sequences; Thomas-Fiering model; t-distribution; Chi-square test; A reliable method of calculating the maximum precipitation; Statistical hypotheses – testing; Parametric and non-parametric models; Comparison with a data; Statistics in forecasting (meteorology and hydrology); Probable maximum and minimum flow;</p>						
<p>Objectives: Explain concepts, methods and models related to probability applications in civil and environmental engineering and compute event probabilities; Apply statistical methods to (a) summarize properties of a data set, (b) fit probability distributions or regression models to data and (c) conduct hypothesis testing;</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Clark, R. Statistical Modelling in Hydrology, John Wiley & Sons 1994 						

Code: GCEE02

PROJECT MANAGEMENT

Field of study: Environmental Engineering						Responsible Persons: dr hab. inż. Marek Wirkus, prof. nadz. PG
Postgraduate studies (MSc – course)						
Full-time studies						Faculty of Management and Economic
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30	15	15			Assessment: test & assignment
<p>Topics: Definition of a project; project characteristics; classification of projects; meaning and scope of projects and project management; project life cycles; project processes, the roles of the project manager, scope management, building a work break structure, stakeholders management; stakeholders roles; responsibility matrix; time planning – the process; activity identification; identify activity relationships; estimating; creating a network; activity –on –arrow diagram and critical path analysis; activity-on-node diagrams; estimating project time; effective time management; scheduling - Gantt charts; assign and level resources; Program Evaluation Review Techniques (PERT); cost planning process; cost –estimating techniques; cost build-up; cost management –budgets; risk management; identify the risk; risk quantification techniques; how to reduce risk; organising for project management; the role of teams; functional organization; the pure project organisation; matrix organizational form; structure selection</p>						
<p>Objectives: The course broadens student’s understanding of project and project management; students will be able to apply basic tools and techniques of project management in practice; write a sponsor and project requirements definition; construct a comprehensive project schedule; evaluate a project plan subject to time, cost and resource constraints. Also the course develops the fundamental skills required of all project managers from both a theoretical and practical viewpoint.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Gray C.E. and Larson E.W., <i>Project management: the managerial process</i>, McGraw- Hill, edition 4e, 2007. 2. <i>A Guide to the Project Management Body of Knowledge</i>, Project Management Institute; 4th edition; ISBN 978-1-933890-51-7. 3. Lockyer K. and Gordon J., <i>Project management and project network techniques</i>, Financial Times Prentice Hall, 7th edition, 2005, ISBN 0-273-69378-6. 4. Kerzner H., <i>Project management: A systems approach to planning, scheduling and controlling</i>, John Wiley & Sons, 10th edition, 2009, ISBN 978-0-470-27870-3. 5. Verzuh E., <i>The Fast Forward MBA In Project Management</i>, Wiley 2nd edition, 2005, ISBN 0-471-69284-0 						

Code: GCEE03

INTERACTIVE DECISION MAKING

Field of study: Environmental Engineering						Responsible Persons: prof. Marian (Mariush) Kemblowski
Postgraduate studies (MSc – course)						
Full-time studies						
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 2
	15	15				Assessment: tests (60%), course work (40%)
<p>Topics: REVIEW OF RELEVANT STATISTICS DECISION THEORY Payoffs, Expected Values, Bayesian Belief Nets (BBNs); Decision Making w/ BBNs, Project Diagnosis w/ BBNs GAME THEORY and CONFLICT RESOLUTION Game components; Game graph: mapping your game; Game Equilibria ; Mixed strategies; Games with Perfect/Imperfect Information Tutorials/ Laboratory: Game theory and Bayesian net software: GAMBIT, NETICA.</p>						
<p>Objectives: The course provides students with knowledge on development and application of statistical-strategic approach to decision making and conflict resolution. The students will become familiar with modelling methods used to analyze and solve interactive decision making problems common in contemporary engineering projects such as: contract negotiations, bid competition process, choosing optimal actions to maximize the payoffs in uncertain environments, and design of information-value based monitoring systems. The students will be working with modern methodologies and computer tools for these problems.</p>						
<p>Recommended literature: Lecture notes Handouts</p>						

Code: GCEE04

FLUID MECHANICS

Field of study: Environmental Engineering						Responsible Persons: dr inż. Piotr Zima
Postgraduate studies (MSc – course)						
Full-time studies						Department of Hydraulic Engineering
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30	15		15		Assessment: exam
<p>Topics: Behaviour, properties and definition of a fluid. Fluid statics, pressure, hydrostatics on flat and curved surfaces, buoyancy. Kinematics of fluid, definition of velocity, acceleration, material derivative, streamlines, streaklines and pathlines. Fluid flow concepts. Finite control volume analysis with continuity, momentum, and energy equations. Navier–Stokes equations. Laminar and turbulent flow. Reynolds equations. Bernoulli and Euler equation. Viscous flows. Pipe flow, energy losses. Open channel flow and its classifications. Uniform flow, rapidly varied flow, gradually varied flow, unsteady flow. Hydraulic structures: weirs, flumes, culverts. Velocity and flow measurement. Principles of groundwater flow. Water quality modelling.</p>						
<p>Objectives: develop an understanding of the principles of fluid mechanics and application of the theory to typical civil engineering problems, including flow in pipes and open channels, fluid measurement, groundwater flow and water quality modelling. The tutorial and laboratory components of the course will allow learning through calculations and experiments relating to main topics of lecture. Students completing this course should have the tools necessary for analysis of field problems in fluid mechanics</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Massey B.; Ward-Smith J.: Mechanics of Fluids (1st-8th ed.), Taylor & Francis, 2. Chadwick A., Morfett C.: Hydraulics in Civil and Environmental Engineering (1st-4th ed.), E & Fn Spon, 3. Chow V. T.: Open Channel Hydraulics, McGraw-Hill Book Company. 						

Field of study: Environmental Engineering						Responsible Persons: dr Katarzyna Jankowska dr inż. Aneta Łucziewicz
Postgraduate studies (MSc – course)						
Full-time studies						Department of Water and Wastewater Technology
Year of study: I Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30			30		Assessment: test
<p>Topics: Microorganisms in production and decomposition of organic matter and in nutrient cycling in aquatic and soil ecosystems. Abiotic factors limiting or enhancing the biological processes. Quality analyses of different ecosystems using the physical, chemical and microbiological parameters. Natural and anthropogenic contaminations. Understanding of the anthropogenic impact on ecosystems. Importance of ecosystems quality in the public health aspects. Ecosystems protection.</p> <p>The practical knowledge about field and experimental ecology. The ecosystems quality in field scale. The relationships between physical, chemical and biological parameters in aquatic and soil ecosystems. The key parameters for ecosystem functioning. The role of anthropogenic impact on ecosystems.</p>						
<p>Objectives: The students should be able to explain the function and development of ecosystems as well as the role of carbon and nutrients cycling. The students should be able to analyze the physical, chemical and microbiological conditions of ecosystems, explain their relationship and the role of limiting factors in carbon and nutrients cycling.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Maier, R.M., I.L. Pepper and C.P. Gerba. 2008. <i>Environmental Microbiology</i>. Second Edition. Academic Press, NY 2. Younos, T. (Editor). 2002. <i>Advances in Water Monitoring Research</i>. Water Resources Publication, LLC., Littleton, Colorado, 230 pp. 3. http://eussoils.jrc.ec.europa.eu/ 4. http://www.eea.europa.eu/ 5. handouts. 						

Field of study: Environmental Engineering						Responsible Persons: dr inż. Ewa Wojciechowska
Postgraduate studies (MSc – course)						
Full-time studies						Department of Sanitary Engineering
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30	15	15			Assessment: exam
<p>Topics: Water resources; types of water intakes; elements of water supply system; system configurations; water demand estimates; transportation and distribution system design and analysis; distribution reservoirs and service storage – types, construction, design; pumps and pumping stations; pump characteristics; wastewater types and quantities; open channel flow sewer system; pressure sewer system; system layout; average rates of flow; variability in sanitary sewage flows; infiltration and exfiltration; design of open channel sanitary sewers; wastewater pumping stations and pressure pipes; pipes materials; manholes; siphones; basics on non-digging methods of sewer renovation; design of stormwater drainage systems; hydrologic considerations; runoff estimation and design flow; system layout; hydraulic design of urban storm drainage systems; stormwater inlets; possibilities of flow reduction by retention and infiltration of stormwater.</p> <p>Tut: Calculations of water demand; calculations of distribution reservoir volume; calculation and drawing of pressure line; calculations of the water distribution system; calculations of wastewater and stormwater drainage flows; calculation of velocities in a sewer system; selection of pumping units.</p> <p>Proj: Design of an open channel sanitary sewer system for an urbanized area (ca. 30 thousand of citizens); system layout; design flows; hydraulic design; drawing of a sewer system map and interceptor sewers profiles.</p>						
<p>Objectives: The course broadens student's understanding of water resources, water consumption and wastewater generation. The course enables student to understand the role, functioning and different configurations of water supply system, sanitary sewer system and stormwater drainage system. The student becomes acquainted with basic aspects of design process and operation. The student is prepared to design a water distribution system and sewer system.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Viessman W Jr., Hammer M.J. <i>Water Supply and Pollution Control</i>. 2. Wang L.K., Okun D., A., Shammam N.K. <i>Water Supply and Wastewater Removal</i>. 3. Sharma A.K., Swamee P.K. <i>Design of Water Supply Pipe Networks</i>. 4. Krenkel P.A., Arnhoff K., Imhoff K. Karl Imhoff's Handbook of Urban Drainage and Wastewater Disposal. 						

Field of study: Environmental Engineering						Responsible Persons: prof. Helena Marecos-do-Monte (Lisbon Superior Engineering Institute (Portugal)) prof. António Albuquerque (University of Beira Interior, Covilha (Portugal)) dr inż. Krzysztof Czerwionka
Postgraduate studies (MSc – course)						
Full-time studies						Department of Water and Wastewater Technology
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 3
	15		15			Assessment: test
<p>Topics: Water reuse – a strategy for water conservation in the framework of water resources management. Quality of reclaimed water (treated wastewater) versus potential health and environmental risks associated with water reuse applications. Conditions affecting the development of water reuse applications: irrigation (agriculture and landscape), non-potable urban applications, industry, groundwater recharge, environmental and recreational applications. Regulations on water reuse. Planning, design and monitoring of reuse of reclaimed water. Economic assessment of water reuse projects. Communication and public acceptance of water reuse.</p>						
<p>Objectives: The course broadens student's understanding about the contribution of water reuse (by means of the use of treated wastewater) to water resources conservation as well as the conditions that affect the sustainability of water reuse.</p> <p>Students become acquainted with the quality characteristics of treated wastewater that affect the reuse of water for several applications such as irrigation, industry, non-potable urban uses, groundwater recharge, recreation and environmental uses. In addition, students are provided with methodologies to assess and stimulate public acceptance and approval of water reuse projects and information about the main regulations on water reuse.</p> <p>The course enables students to apply their acquired knowledge in the design, operation and maintenance, plans evaluation and licensing of water reuse systems.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. AQUAREC – Handbook on Feasibility Studies for Water Reuse Systems, Brussels, Belgium, 2006. 2. ASANO, T.; BURTON, H.; TSUCHIHASHI; TCHOBANOGLIOUS, G. – Water Reuse – Issues, Technologies and Applications. Mc Graw-Hill, New York, 2007. 3. US EPA - Guidelines for Water Reuse. Report EPA/625/R-04/108, Environmental Protection Agency, Washington D.C., USA, 2004. 						

Code: GCEE08

SPATIAL PLANNING

Field of study: Environmental Engineering						Responsible Persons: dr inż. arch. Dominka Wróblewska
Postgraduate studies (MSc – course)						
Full-time studies						Department of Geodesy
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 2
	15					Assessment: test
<p>Topics: The development of settlement systems. The evolution of the spatial planning system in Poland. Methods for analysis and diagnosing the state of the environment and land planning. The idea and strategy of sustainable development. Standards of environmental and urban planning. The study of the conditions and directions of the spatial management of a commune. Land Use Development Plan. The prognosis of the impact of Land Use Development Plan decision on the environment. Problems of the modern spatial planning practice.</p>						
<p>Objectives: Students outline the key planning documents, describes their scope and procedure development. Students describe the principles of environmental protection in planning and sustainable development.</p>						
<p>Recommended literature:</p> <ul style="list-style-type: none"> • Act of 27 th of March 2003 on Spatial Planning and Management (Journal of Laws No. 80 of 2003, item. 717, as amended.) and executive acts and connected acts. • Morphet J.: <i>Effective practice in spatial planning</i>. London; New York, Routledge, 2011. • Pike A., Rodríguez-Pose A., Tomaney J.: <i>Local and regional development</i>. London; New York, Routledge, 2006. • Hugo Priemus H., Button K., Nijkamp P.: <i>Land use planning Cheltenham</i>. Northampton, Edward Elgar, 2007. • Reeves D.: <i>Planning for diversity : policy and planning in a world of difference</i> . London, New York, Routledge, 2005. 						

Field of study: Environmental Engineering						Responsible Persons: dr inż. Adam Szymkiewicz, dr inż. Marzena Wójcik, doc. dr inż. Maria Przewłócka, prof. Jolanta Lewandowska (University of Montpellier 2 (France))
Postgraduate studies (MSc – course)						
Full-time studies						Department of Geotechnics, Geology and Maritime Engineering
Year of study: I / Semester: 1						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30	15		15		Assessment: test (60%) + coursework (40%)
<p>Topics: Lecture: Basic hydrogeological properties of soils and rocks (porosity, storage, permeability, capillarity, soil water retention curve); occurrence of groundwater; groundwater dynamics (flow in saturated and unsaturated zone, interaction with atmosphere and surface water); chemistry of groundwater; major types of contaminants and their properties; transport of dissolved substances (diffusion, advection, dispersion, adsorption); reactive transport; non-aqueous phase liquid contaminants (multiphase flow); overview of soil protection and remediation techniques for hydrocarbons contamination.</p> <p>Tutorials: Analytical solutions of simple groundwater flow and transport problems. Basic design principles for soil protection and remediation techniques.</p> <p>Laboratory: Numerical simulation of flow and transport processes in the subsurface using freely available software (HYDRUS-1D, BIOSCREEN and other).</p>						
<p>Objectives: Student should acquire the following competences: understanding of water flow and contaminant transport processes in the subsurface, modeling capabilities (formulation of the problem, application of relevant computer codes), basic knowledge of soil protection and remediation techniques.</p>						
<p>Recommended literature:</p> <p>Domenico P.A., Schwartz F.W.: <i>Physical and Chemical Hydrogeology</i>. Fetter C.W.: <i>Applied Hydrogeology</i>. Warrick A., <i>Soil water dynamics</i> (available via Knovel Library) Roth K., <i>Soil physics</i> (available via Internet) Kuo J.-F., <i>Practical Design Calculations for Groundwater and Soil Remediation</i> <i>HYDRUS 1-D manual</i> (available via Internet) BIOSCREEN <i>manual</i> (available via Internet)</p>						

Field of study: Environmental Engineering						Responsible Persons: dr inż. Aneta Łucziewicz
Postgraduate studies (MSc – course)						
Full-time studies						Department of Water and Wastewater Technology
Year of study: II / Semester: 2						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 3
	15	15				Assessment: test
<p>Topics: Environmental management - origins of the Environmental Impact Assessment. Scope and purpose of the Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (EIA Directive). The transposition of a EIA Directive into domestic law. Implementation of the EIA procedure into the Polish legal system of environmental protection (objective and stages, examples). The history of performance evaluations and legal regulation in this area. Legal determinants of performance of the EIA. Access to information concerning the environment and public participation in EIA procedure. Duties of administrative authorities in the scope of availability of the information about how to proceed in terms of the EIA issue. Background and current status of the ISO 14000 series, the requirements of ISO 14001.</p> <p>A detailed discussion of the procedures for implementing the EIA and the Environmental Review - stages, examples.</p>						
<p>Objectives: The students should be able to list the criteria for evaluating the environmental aspects. For planning or project purposes the students should identify the need for environmental impact assessments (EIA), plan and delimit environmental consequences of a proposed activity, conduct all essential steps in the production of a written EIA report.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Canter L. - Environmental Impact Assessment. - McGraw-Hill Inc., New York, 1995 2. Morris P. - Methods of Environmental Impact Assessment. - Spon Press London, 2001; 3. http://ec.europa.eu/environment/ 4. handouts. 						

Field of study: Environmental Engineering						Responsible Persons: dr inż. Anna Sobieraj dr inż. arch. Dominka Wróblewska
Postgraduate studies (MSc – course)						
Full-time studies						Department of Geodesy
Year of study: II / Semester: 2						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 3
	30			15		Assessment: test
<p>Topics: Basic concepts of surveying: principles, basic measurements, control networks, locating position. Basic survey measurement: 1) distance measurements - measuring principles, meteorological correction, geometrical reduction, errors, development in EDM (electromagnetic distance measurement), 2) levelling - curvature and refraction, principle of levelling, source of error and closure tolerances, levelling applications, types of levelling (reciprocal, precise, digital, trigonometrical, heighting with GPS), 3) angle and direction measurement - location of points, bearings, azimuths, theodolite and transit, electronic digital theodolites, setting up the theodolite, 4) combined distance and angular measurement systems - total station systems, general function of total station systems, applications of total station systems. Survey measurements and adjustment. Types of surveys: control and topographic surveying, route surveying, construction surveying. Field and office work: planning and design of the survey, remarks, data recording, data collectors, computation and checking. Conventional control surveys: plane rectangular coordinates, traversing, triangulation, networks. Modern surveying: global positioning system, photogrammetric surveying and mapping (sensors and platforms, cameras, scanners and linear sensors, platforms, orthophotography, digital elevation model, geographic information systems). Mapping: digital mapping and spatial information systems. GIS applications.</p>						
<p>Objectives: Student becomes acquainted with basic survey measurements and modern methods used in engineering surveying. The course broadens student's understanding of geographic information systems.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. <i>Schofield W., Breach M.</i>, Engineering surveying. 2. <i>Nitsure S. P., Pawar A. D., Kulkarni L. G.</i>, Basic civil engineering 3. <i>Hycner R., Dobrowolska-Wesołowska M.</i>, Geodesy, surveying and professional ethics. 4. <i>Gopi S., Sathikumar R., Madhu N.</i>, Advanced surveying: total station, GIS and remote sensing 5. <i>Lonley P. A., Goodchild M. F., Maguire D. J., Rhind D. W.</i>, Geographic information systems and science 6. <i>Roy S. K.</i>, Fundamentals of surveying 7. <i>Mesev V.</i>, Integration of GIS and remote sensing 						

Field of study: Environmental Engineering						Responsible Persons: prof. David H. Stensel (University of Washington, Seattle (USA)) prof. Jan Oleszkiewicz (University of Manitoba, Winnipeg (Canada)) dr hab. inż. Jacek Mąkinia, prof. nadzw.PG dr inż. Krzysztof Czerwionka
Postgraduate studies (MSc – course)						
Full-time studies						Department of Sanitary Engineering/Department of Water and Wastewater Technology
Year of study: II / Semester: 2						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 5
	30	15	15			Assessment: exam (60%), project (40%)
<p>Topics: Wastewater sources and flows. Wastewater characterization based on physical and biodegradation criteria. Preliminary treatment unit operations (screens, grit chambers, primary clarifiers). Biological processes (suspended growth vs. attached growth) for wastewater treatment. Principles of biological nutrient removal (nitrification, denitrification, enhanced biological phosphorus removal). Implementation of biological nutrient removal processes in mainstream and sidestream treatment lines. Secondary clarifiers. Advanced treatment processes (tertiary treatment, physical-chemical treatment). Sludge handling processes (thickening, anaerobic vs. aerobic digestion, dewatering). Mathematical models of wastewater treatment processes.</p>						
<p>Objectives: Students get acquainted with techniques for the estimation of wastewater flows, characterization of wastewater quality as well as fundamental understanding of principal unit operations and processes used for wastewater treatment, especially those processes used for biological nutrient removal and sludge handling. Each student prepares a preliminary design of an advanced wastewater treatment plant (ATV A131) and optimizes the design using a computer simulation program (STOAT).</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Metcalf and Eddy, Inc. (2003). <i>Wastewater Engineering, 4th Edition</i>. McGraw Hill, New York. 2. Grady, C.P.L., Daigger G.T. and Lim H.C. (1999). <i>Biological Wastewater Treatment. Second Edition, Revised and Expanded</i>. Marcel Dekker, New York. 3. Henze M., Harremoës P., Jes la Cour J., Arvin E. (1995). <i>Wastewater Treatment. Biological and Chemical Processes</i>. Springer-Verlag Berlin. 						

Code: GCEE13

WATER TREATMENT

Field of study: Environmental Engineering						Responsible Persons: dr inż. Aleksandra Sokolowska
Postgraduate studies (MSc – course)						
Full-time studies						Department of Water and Wastewater Technology
Year of study: II / Semester: 2						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 5
	30	15	15			Assessment: test and project
<p>Topics: Water sources - classification of pollutants. Water components and quality standards. Drinking water regulations and recommendations (WHO, Poland, EU). Health effects. Water treatment operations and processes (physical, chemical and biological). General rules of the Water Treatment Plant design. Types of devices, principles of operations, design directions. Disinfection - kinetics and practice. Drinking water tanks.</p> <p>Calculations: reagent storages, hydraulic and mechanical mixers, reaction tanks, settling tanks, rapid filters, drinking water tanks, distribution pipes.</p> <p>Design of level map and level scheme. Selection and calculations of water treatment installations.</p>						
<p>Objectives: Understanding of the basic principles of unit water treatment processes and design principles of technological lines for different types of water.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Crittenden J., <i>Water Treatment: Principles and Design</i> Wiley; 2 edition, 1, 2005 2. AWWA, <i>Water Treatment Plant Design</i>, McGraw-Hill Professional; 4 edition, 2004 3. Droste, R. L. <i>Theory and Practice of Water and Wastewater Treatment</i>. Hoboken, NJ: Wiley & Sons, 1997. 4. Casey, T. J. <i>Unit treatment processes in water and wastewater engineering</i>, Chichester : John Wiley, 1997. 5. US EPA, <i>Health effects of drinking water treatment technologies : drinking water health effects task force</i> / [Office of Drinking Water, U.S. Environmental Protection Agency, Chelsea, Michigan : Lewis, 1990. 						

Field of study: Environmental Engineering						Responsible Persons: dr inż. Magdalena Gajewska
Postgraduate studies (MSc – course)						
Full-time studies						Department of Water and Wastewater Technology
Year of study: II / Semester: 2						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 5
	30	1	1			Assessment: test
<p>Topics: Waste sources, definitions and classifications, Polish and European union law regulations; Waste management concepts – waste hierarchy, extended producer responsibility (EPR), PPP –polluter pays principle; waste; waste handling and transport, technologies and integrated waste management- landfill and landfill leachate, design and monitoring, incineration, recycling (glass, paper ,plastic, metals), source separation, waste to energy; Sustainability –biological reprocessing, energy recovery (pyrolysis, plasma, RDF, waste to fuel-Polymer Energy), biogas production; Sewage sludge as waste, e-waste, medical waste, hazardous waste management, and bulky waste handling , LCA in waste management</p> <p>Tut: Calculations of calorific value and heat of combustion, sampling and sample preparation for chemical analysis, LCA for different types of waste</p> <p>Proj: Design of source separation for bloc of flats districts, concept of hazardous waste management, concept of incineration plant according to IPPO, concept of integrated waste management for towns, with different number of inhabitancies, with accordance to LCA</p>						
<p>Objectives: The course broadens student’s understanding of waste management and handling, waste recovery and recycling,. The course enables student to understand the role, functioning of different aspects and problems related to integrated waste management. The student becomes acquainted with basic aspects of design process and operation (combustion, source separation, composting). The student is prepared to design or to handle integrates waste management</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1 Salvato J.A, <i>Environmental Engineering and Sanitations</i>. 2. Wang L.K., Okun D., A., Shammass N.K. <i>Water Supply and Wastewater Removal</i>. 3. Bilitewski, Bernd, Härdtle, Georg, Marek, Klaus, <i>Waste Management</i> 4. Hester, Ronald E.; Harrison, Roy M. (Eds.), <i>Electronic waste Management</i> 5. <i>Jurnal of Material Cycles and Waste Management</i> 						

Code: GCEE15

URBAN HYDROLOGY

Field of study: Environmental Engineering						Responsible Person: dr inż. Katarzyna Weinerowska-Bords
Postgraduate studies (MSc – course)						
Full-time studies						Department of Hydrotechnics
Year of study: II / Semester: 2						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 5
	30	15	15			Assessment: exam
<p>Topics: The hydrological cycle in natural and modified environment. Urban catchment and its specificity. Impact of urbanization on the hydrology cycle and quantity of runoff. Effect of “urban heat island”. Role of urban hydrology in designing, verifying and exploitation of engineering structures in urban terrain. Definition of “rainfall-runoff” model. Classifications of hydrological models. Catchment characteristics and their influence on runoff formation. Rainfall as the basic factor determining runoff. Design rainfall. Statistical analysis of rainfall data for local rainfall formulas estimation. Time of concentration. Engineering methods of runoff estimation. Soil Conservation Service Method for determining discharge and volume of runoff. Integrated models (e.g. HEC-HMS) as engineering tools in hydrological analysis of catchment.</p>						
<p>Objectives: The course broadens student’s understanding of the main differences between natural and urbanized catchments and processes determining runoff in both cases. The course enables students to understand the influence of urbanization on different aspects of runoff and the role of urban hydrology in designing, verification and exploitation of engineering structures in urbanized domain. Student becomes acquainted with different aspects of runoff estimation, including choice of method, hydrological data accessibility and accuracy, and the influence of simplification on calculation results.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Akan A.O., Houghtalen R.J.: <i>Urban hydrology, hydraulics and stormwater quality. Engineering applications and computer modeling.</i> 2. Walesh S. G.: <i>Urban Surface Water Management.</i> 3. McCuen R. H., Johnson P. A., Ragan R. M.: <i>Highway Hydrology.</i> 4. Wanielista M., Kersten R., Eaglin R.: <i>Hydrology, Water Quality & Water Control.</i> 5. USACE (United States Army of Corps of Engineers): <i>Hydrologic Modeling System HEC-HMS. Technical Reference Manual.</i> 						

Field of study: Environmental Engineering						Responsible Persons: dr inż. Tomasz Kolerski dr hab. inż. Michał Szydłowski
Postgraduate studies (MSc – course)						
Full-time studies						Department of Hydroengineering
Year of study: II / Semester: 2						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30	15		15		Assessment: test (60%), exercises (40%)
<p>Lecture Topics: Overview of Water: A Physical Perspective; The Hydrologic Cycle - Components, Processes, Human Modification; Global Variation of Precipitation and Evaporation; Factors of the Annual Global Water Budget; Surface Water Hydrology; Water Resource Problems – Global, Poland; Flood, Drought; Water Usage and Supply; Water Demands (Agriculture, Industry, Communal, Recreational); Water Quality - The Complexity of Water Pollution; Major Water Pollutants - Point and Non-Point; Water Supply Systems/Water Treatment; Reservoirs/River Management; Water Uses - Power, Flood Control, Recreation, Water Supply, Navigation; Multiple Use Reservoirs, Multiple Conflicts; Single Purpose Reservoirs; Floods Classification, Reasons and Results; Floods in Polish Water Act and European Water Directive; Modelling of Floods; Numerical Simulations and Mapping (GIS); Flood Risk Zones Determination; Flood Risk Management; The Future of Water Resources Management; Global Water Management Issues; Water Demand in Poland; Climate Change - Global Warming; River Restoration; Cross-vanes; Water Management in Winter Season; Ice Formation Impact on Water Management; Sediment Transport; Erosion and Reservoir Sedimentation;</p>						
<p>Tutorials/Laboratory Topics: Case Studies in Water Management; Applications; Preparation of the Data; Post Processing Analysis; Results Visualization;</p>						
<p>Objectives: Principles and practice of water resources planning and management. A study of the engineering principles involved in analyzing and managing the quantity and quality of water in natural and developed systems. An introduction to surface water hydrology for engineers. This course is designed to acquaint students with the history and practice of water resources planning and management; illustrate the roles of interdisciplinary teamwork, partnerships, and public involvement in planning and management processes and present the elements of integrated water resources planning and management.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 2. Cech, T., V., <i>Principles of Water Resources</i>, John Wiley & Sons, Inc. 2002 3. Chow, V.T., <i>Open-channel Hydraulics</i>, McGraw-Hill, 1959 4. Dzurik, A., A., <i>Water Resources Planning</i> (3rd ed), Rowman & Littlefield Pub. Inc., 2003. 5. Henderson, F., M., <i>Open Channel Hydraulics</i>, Prentice Hall, 1966 6. Shen H. T., <i>Mathematical Modeling of River Ice Processes</i>, Cold Regions Science and Technology, Volume 62, Issue 1, June 2010, Pages 3-13 						

Field of study: Environmental Engineering						Responsible Persons: dr hab. inż. Michał Szydłowski dr inż. Adam Szymkiewicz
Postgraduate studies (MSc – course)						
Full-time studies						Department of Hydroengineering Department of Geotechnics, Geology and Maritime Engineering
Year of study: II / Semester: 3						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30	15		15		Assessment: test (60%), course work (40%)
<p>Topics: Lecture: Role of computer tools in water resources management; mathematical models of flow and contaminant transport in hydrosystems, development of numerical model: preprocessing, simulation and postprocessing; verification, validation and calibration of the model, sensitivity analysis; numerical solution of partial differential equations: spatial discretization methods (finite difference, finite element, finite volume), time discretization methods (explicit and implicit schemes), solution of systems of linear and nonlinear algebraic equations; stability and accuracy of numerical methods, boundary conditions; solution strategies for coupled problems. Examples: one-dimensional advection-diffusion equation; Saint-Venant equations; two-dimensional shallow water flow equations; two-dimensional groundwater flow equations.</p> <p>Tutorials/ Laboratory: Application examples: formulation of the problem, preparing input data, problem solution using freely available numerical codes, visualization of the results.</p>						
<p>Objectives: The course provides students with knowledge on development and application of numerical models. Student should be aware of advantages and limitations of various modeling approaches. Student should be able to choose appropriate computer tools to solve specific problems related to flow and contaminant transport in hydrosystems and to analyze critically the obtained results.</p>						
<p>Recommended literature:</p> <p>Szymkiewicz R., <i>Numerical modeling in open channel hydraulics</i>.</p> <p>Rushton K.R., <i>Groundwater hydrology: conceptual and computational models</i>.</p> <p>Wang H., Anderson M.P., <i>Introduction to groundwater modeling: finite difference and finite element methods</i>.</p> <p>MODFLOW software documentation http://water.usgs.gov/nrp/gwsoftware/modflow2005/modflow2005.html</p> <p>HEC-RAS River Analysis System, <i>Hydraulic Reference Manual</i>, US Army Corps of Engineers, Davis 1997.</p>						

Field of study: Environmental Engineering						Responsible Persons: prof. Marian (Mariush) Kemblowski dr hab. inż. Jacek Mąkinia, prof. nadzw. PG
Postgraduate studies (MSc – course)						
Full-time studies						Department of Sanitary Engineering
Year of study: II / Semester: 3						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 4
	30	15	15			Assessment: test
<p>Topics: •Control volumes and mass balances. Completely vs. incompletely mixed systems. Advective/dispersive transport. Kinematic mixing. Chemical equilibria and mass conservation. Chemical kinetics and partitioning. Air-water gas exchange. Sedimentation. Biodegradation and microbial growth kinetics. Dissolved oxygen behaviour. Eutrophication and heat budgets. Transport and fate in rivers, lakes and estuaries. Water quality models (WASP, QUAL2K, Aquatox, EPD-RIV1, IWA RWQM No. 1).</p>						
<p>Objectives: This course is designed to give students an understanding of processes that govern the behavior of pollutants in the environment (with major emphasis given to surface water). The class will cover fundamentals and principles of formulating water quality models and showing how these models may be applied to environmental engineering problems.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Chapra, S. (1997). <i>Surface Water Quality Modeling</i>, McGraw Hill or (Waveland Press, 2008). 2. Thomann R.V. and Mueller J.A. (1987). <i>Principles of Surface Water Quality Modeling and Control</i>. Harper & Row Publ. 						

Code: GCEE19

THESIS SEMINAR

Field of study: Environmental Engineering						Responsible Persons:
Postgraduate studies (MSc – course)						
Full-time studies						
Year of study: II / Semester: 3						Language: English
Hours in semester	lec	tut	proj	lab	sem	ECTS Points: 2
					30	Assessment: presentation of a report
<p>Topics: Individual presentations of reports on topics related to diploma theses. Active participation of students in seminars and discussions on the presented reports.</p>						
<p>Objectives: Learning of individual literature search/review, preparation of audio-visual report, public presentation and participation in discussions.</p>						
<p>Recommended literature:</p> <ol style="list-style-type: none"> 1. Technical journals 2. Technical books and handbooks 3. Internet resources 4. Other literature 						