Module Handbook

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		UWM Semester of MPE
	ECTS	**Course**
	2	Writing Scientific Papers
	1.5	Environmental Monitoring
	4.5	Environmental Technology
	2	Information Technologies in Environmental Engineering
	2.5	Biological Wastewater Treatment
	2.5	Biotechnology in Environmental Engineering
	1	Block Advanced Technologies Advanced Soil Remediation Systems
	2	Design of Processes in Environmental Biotechnology
	1	English Terminology in Environmental Science
	1.5	Environmental Statistics
	1.5	Monitoring of Aerobic Stabilization of Municipal Solid Waste
	1.5	Selected Issues from Internal Sanitary Installations
	2.5	Techniques of Genetic Engineering
	2.5	Toxicology
	0.25	Ergonomy
	0.5	Etiquette
	0.25	Protection of Intellectual Property
	0.5	Training in Health and Safety at Work
	30	

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

course: Writing Scientific Papers
ECTS 2

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):
Prof. Dr. Habil. Eng. Agnieszka Cydzik-Kwiatkowska (Ms)

Teaching and learning language:
English

Requirements:
No requirements

Objectives of the course:

The aim of this course is to teach the students how to read and write academic papers (posters, master thesis, publications) and how to present the results of the studies to the scientific audience (research platforms, presentations).

Type of course, didactics:

Classes

Contents:
- Variety of academic publications.
- Organizing the paper/thesis.
- Types of abstracts, how to prepare a good abstract.
- Body language
- Vocal training.
- Programs and platforms useful in academic presentation.
- References – rules and modern tools for their preparation.
- Scientific indicators.
- Poster presentations and conferences.
- Presentations by students.

Type of course, didactics:

Classes

Workload:

1) Writing Scientific Papers, total 52 h/2 C (ECTS):

- participation in lectures: 0 h
- participation in classes: 30 h
- consultations: 1 h
- preparation of presentation and reports: 21 h

Verification method (knowledge and skills):
- final report
- preparation of presentation

Literature:
- scientific journals such as Water Research, Bioresource Technology, Science of the Total Environment, Nature.
- Materials for internal use in the Department of Environmental Biotechnology, Łuczyński M. Cydzik-Kwiatkowska A. “How to Write (present and publish) scientific papers” 2019.

course: Environmental Monitoring
ECTS 1.5

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Dr. Habil. Eng. Mariusz Gusiatin, prof. UWM (Mr)

Dr. Habil. Eng. Katarzyna Bułkowska, prof. UWM (Ms.)

Dr. Habil. Eng. Tomasz Pokój, prof. UWM (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge of chemistry and at least basic experience in laboratory work.

Objectives of the course:
Students will have (i) knowledge of the principles of determining chemical parameters in environmental samples and the manners of sample preparation for analysis, (ii) practical skills to operate basic and advanced laboratory equipment and to analyze selected indicators in samples.

Type of course, didactics:
Students take part in laboratory classes. They perform chemical analysis of environmental samples (water, wastewater, soils) in small sub-groups (2-3 students) under the supervision of a lecturer. The students should follow the instructions given in the laboratory handbook. Each laboratory sub-groups prepare a short report.

Contents:
- safety regulations for chemical laboratories. Determination of water indicators: acidity, alkalinity, chemical oxygen demand by permanganate method (CODMn), chloride, total hardness, iron and manganese. Calculation of the concentration of each indicator.
- determination of indicators for raw and treated wastewater: chemical oxygen demand with dichromate method (CODCr), ammonia with Nesslerization and distillation method, nitrate, nitrite, phosphates. Calculation of the concentration of each indicator.
- determination of total metal concentration in soil samples. Introduction to the operation of the Microwave Accelerated Reaction System (MARSXpress) and the atomic absorption spectrometer. Mineralization of soils contaminated with heavy metals using concentrated acids. Preparation of working standard solutions and calibration curves for individual metals. Analysis of heavy metals in soil extracts after mineralization. Estimation of the soil contamination level based on the obtained results.
- determination of PAH concentration in solid and liquid samples. Introduction to the Microwave Accelerated Reaction System (MARS) for sample extraction, solid phase extraction (SPE) and high pressure liquid chromatography (HPLC). Sample preparation for phenanthrene extraction from soil samples. Phenanthrene extraction from soil samples by microwave extraction. Phenanthrene extraction from liquid samples (conditioning of columns in SPE system, sample dosing, washing and drying of column bed, elution, sample drying and dilution in organic solvent). Preparation of a calibration curve. Determination of phenanthrene concentration by HPLC with two detectors: UV-VIS and fluorescence. Analysis of the chromatograms and comparison of the results obtained.
- determination of the critical micelle concentration (CMC) of selected surfactants. Preparation of the solutions of surfactants in a certain concentration range. Measurement of surface tension in the prepared solutions using a tensiometer with Wilhelmy plate method. Determination of the CMC. Elaboration and interpretation of the results.

Workload:

Analytical Training, total 40 h/2 C (ECTS):

- participation in lectures: 0 h

- participation in classes: 30 h
- consultations: 2 h
- preparation for laboratory classes and final test: 8 h
- report preparation: 2 h

Verification method (knowledge and skills):
- final test, report/s
- final mark includes 30% of reports and 70% of test

Literature:

- Artiola, J., Pepper, I. L., & Brusseau, M. L. (Eds.). (2004). Environmental monitoring and characterization. Academic Press.
- American Public Health Association (APHA), 1992., Standard Methods for the Examination of Water and Wastewater, 18th ed., wyd. American Public Health Association, Washington, DC.
- Bułkowska K., Gusiatin M., Pokój T. Environmental monitoring. Laboratory handbook, UWM Olsztyn.
- Analytical Chemistry and Quantitative Analysis", David S. Hage, James R. Carr, 2010.
- Handbook of basic tables for chemical analysis, CRC Press, 2011
- Chemical Analysis in the Laboratory, Baker R., Royal Society of Chemistry, 2002.
- Environmental Analytical Chemistry", Fifield F. W., Haines P. J. Blackwell Science, 2000.
- Environmental Chemistry Solutions Manual, Colin Baird, Michael Cann, 2008.
- Trace Elements in Soils, editor Peter S. Hooda, Wiley-Blackwell, 2010.
- Stephen L.R. Ellison, Vicki J. Barwick, Trevor J. Duguid Farrant Practical Statistics for the Analytical Scientist: A Bench Guide. Publisher: Royal Society of Chemistry; 2nd ed. edition, 2009.
- Gary W. van Loon, Stephen J. Duffy Environmental Chemistry: A global perspective. Publisher: OUP Oxford; 3 edition, 2010.
- Hazardous Materials Characterization: Evaluation Methods, Procedures, and Considerations, Donald A. Shafer, 2006.
- HPLC Methods For Pharmaceutical Analysis, John Wiley & Sons, 2000.
- Heavy Metal Compounds in Soil: Transformation upon Soil Pollution and Ecological Significance, Tatiana M. Minkina, Galina V. Motusova, Olga G. Nazarenko, Saglara S. Mandzhieva, 2010.
- Chemistry of the Environment" (2nd Edition), Thomas G. Spiro, William M. Stigliani, 2002

course: Environmental Technology
ECTS 4.5

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

UWM Dr. Habil. Eng. Magdalena Zielińska (Ms)

UWM Prof. Dr. Habil. Eng. Agnieszka Cydzik-Kwiatkowska (Ms)

UWM Dr. Habil. Eng. Katarzyna Bernat (Ms)

Teaching and learning language:
English

Requirements:
Basic knowledge of chemistry and microbiology, experience in laboratory work.

Objectives of the course:
Students will have knowledge on the technologies used in environmental engineering and methods of their control, and the ability to select technological concepts.

Type of course, didactics:
Students take part in classes, labs and field classes.

Contents:
- Water treatment: iron and manganese removal by aeration-filtration, hardness removal by ion exchange, membrane filtration.
- The use of membrane filtration for wastewater treatment; designing of the Membrane Bioreactors (MBR) technology; energy requirement in the MBRs.
- Evaluation of the effectiveness of wastewater treatment depending on the composition of wastewater; technological parameters of the conventional activated sludge in totally mixed activated sludge reactors. Nitrogen balance in wastewater treatment systems.
- Biomass cultivation technologies in wastewater treatment systems including activated sludge, biofilm and aerobic granular sludge. Enzymatic activity of the biomass. The role of extracellular polymers in formation of complex microbial structures. Evaluation of the abundance and diversity of nitrogen-converting microorganisms using molecular biology methods, depending on the composition of the wastewater. Bioinformatical analysis of high-throughput data.
- Sewage sludge digestion (primary and excess sludge). Respirometric test used in determination of the biogas/methane production during anaerobic processes.

Workload:

1) Environmental technology, total 75 h/4.5 C (ECTS):

- participation in lectures: 0 h
- participation in classes: 75 h
- consultations: 1 h
- preparation of laboratory reports and a project: 10 h
- preparation to test: 10 h
- preparation for classes: 5 h

Verification method (knowledge and skills):
- final test, lab reports, project
- final mark includes 40% of reports+project and 60% of the test.

Literature:

- Zielińska M., Environmental technology – handbook, UWM in Olsztyn.
- Cydzik-Kwiatkowska A., Environmental technology – handbook, UWM in Olsztyn.
- Bernat K., Environmental technology – handbook, UWM in Olsztyn.
- Wojnowska-Baryła I., Cydzik-Kwiatkowska A., Zielińska M., 2010, The application of molecular techniques to the study of wastewater treatment systems, Methods in molecular biology (Clifton, N.J.), 599, 157-183.

- Wilf M., 2010, Membrane technology for wastewater reclamation, Balaban Desalination Publications.
- Wilf M., 2011, Membrane desalination technology, Balaban Desalination Publications.
- Snyder L., Champness W., 2007, Molecular Genetics of Bacteria, ASM Press, p. 735.

course: Information Technologies in Environmental Engineering
ECTS 2

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Dr Habil. Eng. Katarzyna Bułkowska, prof. UWM (Ms)

Teaching and learning language:
English

Requirements:
Basic knowledge of mathematics.

Objectives of the course:
Students will be getting acquainted with the methods used to create mathematical models of processes in environmental engineering.

Type of course, didactics:
Students take part in classes. They perform projects.

Contents:
- Introduction to the mathematical modelling environment of selected processes in environmental engineering. Discussion of modelling goals.
- Presentation of the methodology (stages) of creating a mathematical model.
- Modelling the growth kinetics of the population of microorganisms.
- Monod model. Modelling of biochemical changes.
- Mathematical modelling of selected processes in environmental engineering.
- Optimization of process parameters and bioreactor design.

Workload:

1) Information Technologies in Environmental Engineering, total 52 h/2 C (ECTS):

- participation in lectures: 0 h
- participation in classes: 30 h
- consultations: 1 h
- preparation of projects: 16 h
- preparation for classes: 5 h

Verification method (knowledge and skills):
- projects

Literature:

- Hritonenko, N., & Yatsenko, Y. (2003). Applied mathematical modelling of engineering problems (Vol. 81). Springer Science & Business Media.
- McKellar, R. C. (1997). A heterogeneous population model for the analysis of bacterial growth kinetics. International Journal of Food Microbiology, 36(2-3), 179-186.
- Alvarez-Ramirez, J., Meraz, M., & Vernon-Carter, E. J. (2019). A theoretical derivation of the Monod equation with a kinetics sense. Biochemical Engineering Journal, 150, 107305.
- Weinrich, S., Mauky, E., Schmidt, T., Krebs, C., Liebetrau, J., & Nelles, M. (2021). Systematic simplification of the Anaerobic Digestion Model No. 1 (ADM1)–Laboratory experiments and model application. Bioresource technology, 333, 125104.
- Panaro, D. B., Frunzo, L., Mattei, M. R., Luongo, V., & Esposito, G. (2021). Calibration, validation and sensitivity analysis of a surface-based adm1 model. Ecological Modelling, 460, 109726.

course: Biotechnology in Environmental Engineering
ECTS 2.5

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Dr. Habil. Eng. Katarzyna Bułkowska, Assoc. Prof. (Ms)

Dr. Habil. Eng. Mariusz Gusiatin, Assoc. Prof. (Mr)

Dr. Habil. Eng. Tomasz Pokój, Assoc. Prof. (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge of mathematics, chemistry, biochemistry and microbiology, and basic experience in laboratory work.

Objectives of the course:
Students will acquire (i) knowledge of the use of biological systems to protect and restore the environment the use of technological systems compatible with the concept of sustainable development, (ii) the ability to apply different techniques of environmental biotechnology and evaluate their efficiency.

Type of course, didactics:
Students attend lectures and laboratory classes. They conduct experiments under various operating conditions and control processes by performing chemical analyses of samples. They work in small teams of 3-4 students and are supervised by a lecturer. Students should follow the instructions in the lab handbook. Each lab team prepares a report.

Contents:

- Techniques for remediation and bioremediation of soils contaminated with heavy metals. Characteristics and criteria for classification of methods for remediation of soils contaminated with heavy metals. Phytoremediation as a strategy for soil treatment. Types and properties of biosurfactants used in bioremediation of soils. Evaluation of the efficiency of metal removal from soil depending on different operating conditions of soil washing with biosurfactant solutions: determination of selected properties of biosurfactant stock solutions (surface tension, pH, electrical conductivity); preparation of washing solutions; preparation of soil samples for experiments; performance of soil washing process under different process configurations (biosurfactant concentrations, extraction time, mass/volume ratio, multiple soil washing); determination of metal concentration in samples after soil washing process using atomic absorption spectrometer. Determination of kinetic constants of metal removal from soil and efficiency of the process.
- Techniques for remediation and bioremediation of polycyclic aromatic hydrocarbon (PAH) contaminated soils. Classification and characteristics of bioremediation methods for removal of oil and oil products from contaminated soils. Evaluation of the effect of mass/volume ratio and washing time on the removal of PAH from soils with biosurfactants under batch conditions: preparation of a base solution and a working solution of surfactants (SAA); preparation of soil samples; determination of the critical micelle concentration of SAA before and after washing soil samples; determination of PHA concentration in soil samples by high-pressure liquid chromatography, including microwave and solid-phase extraction of PHA. Calculation of the total concentration of PHAs in the soil sample, the concentration of PHAs removed from the soil sample, and the efficiency of PHA removal from the soil.
- The use of biosorption to remove dyes from wastewater. Characteristics of sorbents and biosorbents for the treatment of colored wastewaters. Evaluation of the influence of pH on the efficiency of adsorption of dyes from aqueous solutions on chitin: preparation of working standard solutions of dyes at different pH values; preparation of chitin samples; carrying out the adsorption process of dyes under batch conditions; determination of dye concentration before and after the adsorption process. Determination of the amount of adsorbed dye per mass of chitin at equilibrium. Determination of the equations and constants of the adsorption isotherm using the Freundlich and Langmuir models.

- Technological strategies for biodegradable polymers. Natural polymers for the production of bioplastics. Strategies for the production of PHAs with pure cultures and mixed microbial consortia using renewable waste materials as substrates. Properties and applications of PHAs. Evaluation of the influence of the carbon/nitrogen ratio in the culture medium on the efficiency of PHA accumulation in activated sludge: preparation of the culture medium with a chemically defined composition; performance of batch cultivation of mixed cultures under aerobic dynamic feeding conditions at high and low carbon/nitrogen ratios; analysis of the concentrations of total organic carbon and ammonia and polyhydroxyalkanoates with a gas chromatograph at specific cultivation times. Determination of kinetic constants, rates of substrate consumption, and PHA accumulation. Calculation of the PHA yield coefficient and volumetric productivity.

Workload:

1) Biotechnology in Environmental Engineering, total 45 h/2.5 C (ECTS):

- participation in lectures: 11 h
- participation in classes: 34 h
- consultations: 1 h
- preparation of laboratory reports: 6 h
- preparation for the exam: 10 h
- preparation for classes: 5 h

Verification method (knowledge and skills):
- laboratory reports
- final exam (test, 90 min),
- final mark includes 40% of reports and 60% of exam test

Literature:

- Khan F.I., Husain T., Hejazi R. 2004. An overview and analysis of site remediation technologies. Journal of Environmental Management 71: 95-122.
- Mulligan C.N. 2005. Environmental applications for biosurfactants. Environmental Pollution 133: 183-198.
- Gupta V.K., Suhas. 2009. Application of low-biosorbents for dye removal – a review. Journal of Environmental Management 90: 2313–2342.
- Chen G.Q., 2010. Plastics from Bacteria. Natural Functions and Applications. Springer-Verlag, Berlin Heidelberg, Germany.
- Padmavathiamma P. K., Li L.Y. 2007. Phytoremediation technology: hyper-accumulation metals in plants. Water Air Soil Pollution 184: 105-126.
- Gan, S., Lau, E.V., Ng, H.K. 2009. Remediation of soils contaminated with polycyclic aromatic hydrocarbons (PAHs) Journal of Hazardous Materials, 172 (2-3): 532-549.
- Serafim, L.S., Lemos, P.C., Albuquerque, M.G.E., Reis, M.A.M. 2008. Strategies for PHA production by mixed cultures and renewable waste materials. Applied Microbiology and Biotechnology, 81 (4): 615-628.

course: Advanced Soil Remediation Systems
ECTS 1.0

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer:

Dr. Habil. Eng. Mariusz Gusiatin, prof. UWM (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge about soil science, environmental pollutants.

Objectives of the course:
Familiarize students with advanced remediation systems for contaminated soils. Train students in the ability to select and evaluate remediation systems.

Type of course, didactics:
Auditorium exercises with the use of PPT presentations, YouTube materials, course materials prepared by teacher, discussion

Contents:
Pollutants in the soil environment and their behavior. Presentation of selected engineered systems of soil remediation, e.g. permeable reactive barriers (PRB), metal immobilization with new amendments, geotubes etc. Technologies of soil mixing. Calculations for groundwater and soil remediation. Analysis of selected case studies on soil remediation.

Workload:

Advanced soil remediation systems, total 26 h/2 C (ECTS):

- participation in classes: 20 h
- consultations: 2 h
- preparation for presentation: 6 h

Verification method (knowledge and skills):
- presentation and calculation report

Literature:
Erickson, L. E., Pidlisnyuk, V. (2021). Phytotechnology with Biomass Production: Sustainable Management of Contaminated Sites (p. 242). Taylor & Francis.

Reddy, K., Adams, J. (2015). Sustainable remediation of contaminated sites. Momentum Press.

Naftz, D., Morrison, S. J., Fuller, C. C., Davis, J. A. (Eds.). (2002). Handbook of groundwater remediation using permeable reactive barriers: applications to radionuclides, trace metals, and nutrients. Academic Press.

Online resources: publications on soil and grounwater remediation in different database (e.g. Scopus).

course: Design of Processes in Environmental Biotechnology
ECTS 2

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Dr. Habil. Eng. Katarzyna Bułkowska (Ms)

Teaching and learning language:
English

Requirements:
Basic knowledge of environmental engineering processes.

Objectives of the course:
Students will have knowledge of the technologies for sewage sludge composting. Students will be able to calculate of PHAs production by mixed microbial cultures. Students will be able to describe methods for biodiesel production. Students will be able to describe the technological concept of methyl esters production in a batch reactor. They will have knowledge of soil bioremediation and factors affecting the process efficiency.

Type of course, didactics:
Students take part in classes. Students perform calculations on specific technological processes..

Contents:
- Design of composting dewatered sewage sludge with lignocellulosic materials as amendments.
- Calculation of PHAs production by mixed microbial cultures using waste materials as substrates.
- Technological concept of methyl esters production in a batch reactor.
- Technological concept of biodiesel production.
- Calculations of process requirements for bioremediation of soils contaminated with petroleum in biopile system.

Workload:

1) Design of Processes in Environmental Biotechnology, total 52 h/2 C (ECTS):

- participation in lectures: 0 h
- participation in classes: 30 h
- consultations: 1 h
- preparation of projects: 12 h
- preparation to final test: 9 h

Verification method (knowledge and skills):
- final test,
- projects.

Literature:

- Kulikowska, D., & Bernat, K. (2021). Waste willow-bark from salicylate extraction successfully reused as an amendment for sewage sludge composting. Sustainability, 13(12), 6771.
- Sabapathy, P. C., Devaraj, S., Meixner, K., Anburajan, P., Kathirvel, P., Ravikumar, Y., ... & Qi, X. (2020). Recent developments in Polyhydroxyalkanoates (PHAs) production–A review. Bioresource technology, 306, 123132.
- Tabatabaei, M., Aghbashlo, M., Dehhaghi, M., Panahi, H. K. S., Mollahosseini, A., Hosseini, M., & Soufiyan, M. M. (2019). Reactor technologies for biodiesel production and processing: A review. Progress in Energy and Combustion Science, 74, 239-303.
- Ambaye, T. G., Vaccari, M., Bonilla-Petriciolet, A., Prasad, S., van Hullebusch, E. D., & Rtimi, S. (2021). Emerging technologies for biofuel production: A critical review on recent progress, challenges and perspectives. Journal of environmental management, 290, 112627.
- Zhang, K., Wang, S., Guo, P., & Guo, S. (2021). Characteristics of organic carbon metabolism and bioremediation of petroleum-contaminated soil by a mesophilic aerobic biopile system. Chemosphere, 264, 128521.

curse: English Terminology in Environmental Science
ECTS 1.0

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Dr. Habil. Eng. Mariusz Gusiatin, prof. UWM (Mr)

Dr. Habil. Eng. Maciej Woźny, prof. UWM (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge about the environment.

Objectives of the course:
Familiarization with specialized vocabulary and language structures necessary to communicate in the field of natural and technical sciences. Developing professional language skills.

Type of course, didactics:
Auditorium exercises with the use of PPT presentations, YouTube materials, course materials prepared by teacher, discussions, individual and team tasks.

Contents:
Milestones in molecular biology. Cell structure and function. Drug discovery. Emerging problem of microplastics. Renewable energy technologies. Bioreactor design and operation. Food bioprocessing. Waste biorefinery. Biofuel technology. Phytotechnology - a green key for pollution. Value-added products recovered from sludge. PFAS - "forever" chemicals.

Workload:

English Terminology in Environmental Science, total 26 h/2 C (ECTS):

- participation in classes: 20 h
- consultations: 2 h
- consolidation of specialized terminology and preparation for entry tests: 6h

Verification method (knowledge and skills):
- vocabulary tests at the beginning of each class

Literature:
Pfafflin, J. R., Ziegler, E. N., & Lynch, J. M. (2007). The dictionary of environmental science and engineering. Routledge.
Online resources: https://howjsay.com/ (for pronunciation); https://www.macmillandictionary.com/ (includes examples with grammar and collocations for English language learners); https://www.thefreedictionary.com/ (has more detailed definitions, examples are not so useful)

course: Environmental Statistics
ECTS 1.5

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Prof. Dr. Habil. Eng. Paweł Brzuzan (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge of statistics.

Objectives of the course:
To become familiar with the concepts of random variation, statistical distributions, significance tests. To apply the statistical methods useful for the work of environmental scientists.

Upon completion of the programme of study, the graduate will acquire the following:

Knowledge: of statistical methods that will be useful to environmental scientists and managers in their work; **Skills**: practical tips on collecting and analysing data; **Social competences**: to share the knowledge and skills with the community regarding the importance of handling data appropriately and applying statistical methods in different environmental contexts.

Type of course, didactics:
Students take part in auditorium classes. Under the supervision of the lecturer, students carry out tasks independently, discuss the results of their calculations, draw conclusions from the data. Students should follow the instructions given at the beginning of each lesson. Each student writes 2 tests with several tasks covering the topics of the programme.

Contents:
CLASSES: The role of statistics in environmental science (the importance of statistics in examples). Environmental sampling (simple and stratified random sampling, estimation of population means, totals, and proportions, ratio estimation). Models for data (statistical models, discrete and continuous statistical distributions, One-, and Two-Factor analysis of data). Drawing conclusions from data (description of observational and experimental studies, true experiments and quasi-experiments, tests of significance and confidence intervals). Environmental monitoring (purposely chosen monitoring sites, detection of changes using Control Charts, Chi-squared tests for a change in a distribution). Impact assessment (Before-after-impact-control (BACI) designs), Assessing site reclamation (the concept of bioequivalence). Risk assessment.

Workload:

Classes 30h

Verification method (knowledge and skills):
- Two tests (2x80 min)

Literature:
Manly, B.F. J. Statistics for environmental science and management. 2nd ed., , Chapman and Hall/CRC , 2010

Penningroth, S., Essentials of Toxic Chemical Risk Science and Society, CRC Press, London, 2010

Supplementary literature:

Any handbook of Statistics

course: Monitoring of aerobic stabilization of municipal solid waste
ECTS 1.5

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Dr. Eng. Sławomir Kasiński (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge on composting process and at least basic experience in laboratory work.

Objectives of the course:
The student will have (I) knowledge of the basic technological aspects of the process of stabilizing waste in conditions aerobic, tendencies of changes in physicochemical parameters during the process, including their dependence on the degree stability of waste. After completing the course, the student should have basic skills (II) in the field of optimization the process of municipal waste stabilization on a technical scale, based on the analysis of basic criteria stability. During the classes, the student acquires the skills (II) to assess the effectiveness of the technological process based on the biological treatment of municipal waste under aerobic conditions. The student masters the basics of laboratory techniques in the analysis of conditions taking place inside an aerobic stabilization reactor.

Type of course, didactics:
The course begins with theoretical part, during which students learn the basics of the aerobic decomposition of municipal waste and the methods used for estimation of the biological stability.
After the theoretical part of the course the students take part in practical part. After the preparation of the test stand in semi-technical scale, the students - divided into 2-3 person subgroups – analyze for 30 days the physicochemical and biological changes passively aerated reactor. The scope of work of individual sub-groups includes the observation of daily changes in temperature and mass of stabilized waste, as well as the collection of samples from the reactor and subjecting them to laboratory tests (sample preparation, determination of waste moisture, determination of respirometric activity and loss of ignition). Each laboratory sub-group prepare a short partial report (skills).
The results made by individual sub-groups are collected in the cloud. Based on all the results and knowledge obtained during the auditorial classes, each student prepares a final report (knowledge).

Contents:
- Preparation of the test stand in semi-technical conditions. Explanation of the principles of operation of a passively aerated reactor. Initial characterization of the substrate - measurement of moisture, AT4 activity and LOI in the substrate. Filling of the research reactor. Measurement of initial mass and reactor temperature.
- Division of the group into subgroups. Observation of changes in the research reactor during the 30 days of the stabilization process. Monitoring the physicochemical changes of the waste in each subgroup for 5 consecutive days - using the learned techniques to estimate the degree of stability of the waste using the Oxitop Control® method and the degree of mineralization (LOI).
- Final classes - summary and discussion of the results obtained by all subgroups.

Workload:

1) Analytical Training, total 42 h/1.5 C (ECTS):

- participation in lectures: 0 h
- participation in classes: 20 h
- consultations: 2 h
- preparation of laboratory reports (monitoring of the process): 18 h
- preparation to test: 0 h
- preparation for classes: 2 h

Verification method (knowledge and skills):

- partial report (skills) and final report (knowledge)
- final mark includes 40% of partial report and 60% of final report

Literature:

- Roger Tim Haug, The Practical Handbook of Compost Engineering, pub. CRC Press, 1993
- Heribert Insam, Nuntavun Riddech, Susanne Klammer, Microbiology of Composting, pub. Springer, 2002
- T. V. Ramachandra, Management of Municipal Solid Waste, pub. TERI Press, 2006
- L.F. Diaz, M. de Bertoldi, W. Bidlingmaier, Compost Science and Technology, pub. Elsevier, 2011
- Robert Rynk, The Composting Handbook: A How-to and why Manual for farm, municipal, institutional and commercial Composters, Academic Press, 2021
- Julian Doberski, The science of compost, pub. Pimpernel Press Ltd, R. 2022

course: Selected Issues from Internal Sanitary Installations
ECTS 2

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Prof. Dr. Habil. Eng. Wojciech Janczukowicz (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge of mathematics and physics.

Objectives of the course:
Students will have (i) knowledge of the principles of designing water, sewage and gas installations, (ii)

practical basic ability to design water, sewage and gas installations.

Type of course, didactics:
Students take part in designing classes. They determine the demand for water and gas, amount of domestic wastewater and rainwater, dimension water supply connection to residential house, water, gas and wastewater pipes inside the house, design of house sewer, household sewage treatment plant devices and rainwater drainage. They estimate the cost of sewerage system options and specify economic benefits of rainwater reusing. Every student prepares individual design exercise with two technological schemes of household wastewater treatment plant.

Contents:
- Determining the demand for water and characteristic flows, hydraulic and pressure calculations of the water supply network, dimensioning of the water supply connection.
- Designing a sewage system for a residential building area, determining the amount of domestic wastewater, characteristic flows, determination of diameters and hydraulic calculations.
- Design of water installation, characteristic flows, determination of diameters, hydraulic calculations.
- Design of wastewater installation, characteristic flows, determination of diameters, hydraulic calculations.
- Calculation of the amount of gas depending on the type of gas. Design calculations for gas connection to the building and internal gas installation.
- Calculation of the cost of sewerage system options (drainage and non-outflow sewage systems).
- Design of a house sewer and household sewage treatment plant. Estimation of wastewater treatment efficiency, selection of the sewage treatment plant scheme depending on the sewage receiver. Calculation of septic tank, seepage pit, drain field, sand filter and reed beds.
- Designing rainwater drainage pipes. Calculation of rainwater flows and annual amount, runoff replacement coefficient, economic benefits coming from rainwater reusing.

Workload:

1) Design exercises, total 42 h/1,5 C (ECTS):

- participation in lectures: 0 h
- participation in classes: 30 h
- consultations: 2 h
- preparation to test: 5 h
- preparation of homework (design exercise homework): 5 h

Verification method (knowledge and skills):
- final test, homework (design exercise)
- final mark includes 30% of homework and 70% of test

Literature:

- Bąkowski K., Networks and gas installations, Wyd. PWN Warsaw, 2008

- Tecz Z., Bąk P., Materials technology, hot and cold installations water, gas installations, sanitary devices, Wyd. REA, Warsaw, 1998
- Chudzicki J., Sosnowski S., Sewage installations – design execution, exploitation, ed. Seidel-Przywecki Warsaw, 2009
- Sosnowski S., Tabernacki J., Chudzicki J., Water supply and sewage installations, Wyd. Polish Installer Warsaw, 2000
- Bąkowski K., Chudzicki J., Sanitary installations. A new construction foreman's guide, Wyd. Arkady, 2003
- McGhee T.J., Water supply and sewerage, McGraw-Hill International Editions, International Edition, 1999
- Nicoll E.H., Small water poluution control works, design and practice, Ellis Horwood, 1992

course: Techniques of Genetic Engineering
ECTS 2

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Prof. Dr. Habil. Eng. Sławomir Ciesielski (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge of biology and at least basic experience in laboratory work

Objectives of the course:
The primary goal of this course is to introduce the concepts and practice of genetic engineering, with emphasis on application of molecular techniques in ecological engineering.

Type of course, didactics:
Students take part in lectures and laboratory classes. Lectures are given with the help of presentation projector. During laboratory classes students perform analysis of samples originated from wastewater treatment plant (activated sludge, biofilm) in pairs under the supervision of an instructor. The students follow the instructions given in the laboratory handbook. At the end of the course each pair of students prepare a report.

Contents of lecture:
- Structure and properties of basic biomolecules.
- Application of molecular techniques in environmental biotechnology for monitoring of microbial systems. Molecular approaches to the assessment of microbial community biodiversity.
- Analysis of microbial dynamics during biological processes of wastewater treatment using fingerprinting methods (AFDRA, ARDRA, DGGE\TGGE, RISA).
- Application of metagenomics in ecological engineering
- Genetic engineering as the tool for the improvement of biological systems
- Biosensors in environmental monitoring

Contents of laboratory classes
- Extraction of nucleic acids from activated sludge or biofilm.
- Polymerase Chain Reaction (PCR) and agarose electrophoresis.
- Polyacrylamide gel electrophoresis. Estimation of microbial diversity by Ribosomal Intergenic Spacer Analysis (RISA).
- Detection of catabolic genes and bioremediation monitoring by Polymerase Chain Reaction (PCR).
- Plasmid isolation from E. coli. Plasmid restriction analysis. Agarose gel electrophoresis of digested plasmids. Restriction analysis.

Workload:

1) Techniques of Genetic Engineering, total 30 h/2.5 C (ECTS):

- participation in lectures:6 h
- participation in classes: 24 h
- consultations: 10 h
- preparation of laboratory reports: 15 h

- preparation to test: 15 h
- preparation for classes: 5 h

Verification method (knowledge and skills):
- final mark for lectures - writing test (45 min.)
- final mark for classes includes 60% of reports and 40% of test

Literature:

- Brown T.A., 2001, Gene Cloning and DNA Analysis: An Introduction. Blackwell Science, 363 pp.
- Nicholl D.S.T., 2002, An Introduction to Genetic Engineering. Cambridge University Press, 292 pp.
- Ciesielski S. Techniques of Genetic Engineering. Laboratory handbook, UWM Olsztyn.
- Glick B. R., Pasternak J. J., Patten C. L., 2010, Molecular Biotechnology. Principles and applications of recombinant DNA. ASM Press, 1000 pp.
- de Bruijn F. D., 2011, Handbook of molecular microbial ecology: Metagenomics in different habitats, Wiley Blackwell, 640 pp.

course: Toxicology
ECTS 2.5

Duration: 1 Semester
Semester: Summer Semester MPE2
Frequency: always in the Summer Semester MPE2
Availability: for MPE students

Lecturer(s):

Prof. Dr. Habil. Eng. Paweł Brzuzan (Mr)

Dr. Habil. Eng. Maciej Woźny (Mr)

Teaching and learning language:
English

Requirements:
Basic knowledge of biology and chemistry and at least basic experience in laboratory work.

Objectives of the course:
Upon completion of the programme of study, the graduate will acquire the following:

Knowledge: of target organs and toxic endpoints of environmental toxins, understanding of toxicity mechanisms of various pollutants, **Skills**: The graduate will become expert in various molecular biology laboratory techniques,

Social skills: The graduate will be able to explain the importance of toxicological approaches for human risk assessment.

Type of course, didactics:
Students take part in lectures and laboratory classes. They perform analysis of gene expression after exposure to model toxic substance (a case study), and look into the mechanisms of detoxication through analysis of participating genes, in small sub-groups (2-3 students) under the supervision of a lecturer. The students should follow the instructions given in the laboratory handbook. Each laboratory sub-groups prepare a short report.

Contents:
CLASSES: Health and Safety regulations, organizational issues, introduction to the subject. User manual of the molecular biology equipment. Pippetting micro volumes of liquids with different physical properties (density, viscosity). Part I. Analysis of gene expression after exposure to model toxic substance (a case study): Total RNA isolation. Spectrophotometric measurement of quantity and purity of the isolated samples. Assessment of RNA integrity. Elimination of genomic DNA from the samples. Reverse transcription. Introduction to nonparametric statistical tests. GenBank search for nucleotide sequences. Polymerase chain reaction (PCR) primers design. Analysis of gene expression using semi-quantitative PCR (SQ-PCR). Analysis of gene expression using real-time quantitative PCR (qPCR). Calculations on raw values, presentation of the obtained results, analysis for statistical significance. Preparation of laboratory report. Overview of the current scientific literature available online. Part II. Polymorphism analysis of genes participating in detoxication mechanism: Isolation of genomic DNA from students' cheek swab. Conventional PCR. Agarose electrophoresis. Analysis and interpretation of the obtained results.
LECTURES: We introduce the basics of toxicology from a risk analysis perspective. The lectures are organized into 3 basic threads and include the following topics Toxic chemical risk. Environmental pathways of toxic chemicals. The body's defenses against chemical toxicity. Mechanisms of chemical disease. PCR-based protocols in molecular toxicology.

Workload:

Classes 25 h

Lectures 5 h

Verification method (knowledge and skills):
- final test, report/s
- final mark includes 40% of reports and 60% of test (test duration 90 min)

Literature:

Brzuzan P., Woźny M.,, Toxicology. Student's coursebook. , Deparment of Environmental Biotechnology, d. University of Warmia and Mazury in Olsztyn, Poland, 2020
Penningroth, S.,, Essentials of Toxic Chemical Risk Science and Society, CRC Press, London, 2010
Walker C. H., Hopkin S. P., Sibly R. M., Peakall B., , Principles of Ecotoxicology, Third Edition., , CRC Press., 2005
McCarthy J.F., Shugart L.R.,, Biomarkers of environmental contamination.,, Lewis Publishers, 1990

Obligatory UWM courses:

Ergonomy (ECTS 0.25, 2 h)
Etiquette (ECTS 0.5, 4 h)
Protection of Intellectual Property (ECTS 0.25, 2 h)
Training in Health and Safety at Work (ECTS 0.5, 4 h)

Total ECTS 1.5

Ergonomy
Educational goal: Familiarization with the principles of ergonomics.
Course contents: Ergonomics - basic concepts and definitions. Ergonomics as an interdisciplinary science Main trends in ergonomics: ergonomics of the workplace (physical effort at the workplace, mental effort at the workplace, anthropometric adjustment of the workplace, material working environment), product ergonomics - engineering of ergonomic quality, ergonomics for the elderly and disabled. Ergonomics of standing and sitting work.

Etiquette
Educational goal: familiarization with selected issues concerning the principles of savoir-vivre.
Course contents: basic issues concerning the principles of savoir-vivre in everyday life - honorifics, greetings, basic rules of etiquette and precedence in public places. Academic etiquette - precedence, titles, rules of business correspondence. Elements of business etiquette - adapting the dress to the circumstances, rules of presentation, preparation for the interview.

Protection of Intellectual Property
Educational goal: familiarization with the elementary principles, concepts and procedures of intellectual property law. Course contents: the concept of intellectual property. The subject of intellectual property law. Subjects of intellectual property law. The content of intellectual property law - copyright and related rights. Copyright Restrictions. Statutory and Contractual Licenses. Permitted personal and public use of works. Copyright infringement (plagiarism and intellectual piracy). Specific regulations in the field of copyright - protection of computer programs and databases.

Training in Health and Safety at Work
Educational goal: providing basic information on the general rules of conduct in the event of an accident during learning and in emergency situations, circumstances and causes of accidents, first aid rules in the event of an accident, as well as an indication of potential threats.
Course contents: legal regulations in the field of occupational health and safety. Applicable laws, and regulations on occupational health and safety at universities. Identification, analysis and assessment of threats to life and health in individual fields of study (dangerous, harmful and burdensome factors). Analysis of the circumstances and causes of accidents. General rules of conduct in the event of an accident while learning and in emergency situations (e.g. fire). Principles of first aid in the event of an accident - first aid kit.