Faculty of Environmental Management and Agriculture

WEST POMERANIAN UNIVERSITY OF TECHNOLOGY
IN SZCZECIN, POLAND

THE OFFER FOR INTERNATIONAL STUDENTS FOR THE YEAR 2021/2022 SECOND DEGREE

	Course title	Person responsible for the course	Semester (winter/summer)	ECTS points	Hours
1	ABIOTIC AND BIOTIC STRESS IN PLANTS	Marcelina Krupa-Małkiewicz	winter/summer	5	40
2	AGRICULTURAL BIOMASS PRODUCTION FOR ENERGY PURPOSES	Marek Bury	winter/summer	4	30
3	AGROPHYSICS	Romualda Bejger	winter/summer	3	20
4	ALTERNATIVE QUELLEN DER ENERGIE IN DER LANDWIRTSCHAFT	Marek Bury	winter/summer	4	30
5	ANBAU VON ALTERNATIV-PFLANZENARTEN	Marek Bury	winter/summer	3	30
6	AQUATIC PLANTS	Małgorzata Gałczyńska	winter/summer	6	60
7	ARABLE LAND MANAGEMENT SYSTEMS	Marek Bury	winter/summer	4	30
8	BASICS OF WATER MANAGEMENT IN THE CATCHMENT	Grzegorz Jarnuszewski	winter/summer	2	14
9	BIOCHEMISTRY	Arkadiusz Telesiński	winter/summer	5	45
10	BIOMASSEPRODUKTION ZUR ENERGIEGEWINNUNG	Marek Bury	winter/summer	4	30
11	BIOTECHNOLOGY FOR ENVIRONMENT PROTECTION	Piotr Masojć	winter/summer	6	60
12	BIOTECHNOLOGY IN AGRICULTURE	Piotr Masojć	winter/summer	6	60
13	BIOTECHNOLOGY OF HERBAL PLANTS	Marcelina Krupa-Małkiewicz	winter/summer	5	40
14	CROPS OF THE TROPICS AND SUBTROPICS	Marek Bury	winter/summer	4	30
15	CULTIVATION TECHNOLOGY OF CEREALS AND LEGUMES	Marek Bury	winter/summer	6	65
16	CULTIVATION TECHNOLOGY OF ENERGY CROPS	Marek Bury	winter/summer	6	60
17	CULTIVATION TECHNOLOGY OF ROOT CROPS AND INDUSTRIAL PLANTS	Marek Bury	winter/summer	6	65
18	DECORATING WITH PLANTS	Piotr Salachna	winter/summer	4	30
19	DIFFERENTIAL EQUATIONS	Arkadiusz Telesiński	winter/summer	5	50
20	ECOLOGY	Joanna Podlasińska	winter/summer	5	50
21	ECOMONITORING AND BIOINDICATION	Joanna Podlasińska	winter/summer	5	40
22	ECOTOXICOLOGY	Arkadiusz Telesiński	winter/summer	5	45
23	EDIBLE FLOWERS	Kamila Bojko	winter/summer	5	40
24	ENVIRONMENTAL ANALYTICAL CHEMISTRY	Małgorzata Włodarczyk	winter/summer	7	75
25	ENVIRONMENTAL CHEMISTRY	Małgorzata Gałczyńska	winter/summer	6	60
26	ENVIRONMENTAL POLLUTION	Joanna Podlasińska	winter/summer	5	40
27	EVOLUTION ON MOLECULAR LEVEL	Piotr Masojć	winter/summer	3	30
28	FLORAL DESIGN	Piotr Salachna	winter/summer	4	30

	Course title	Person responsible for the course	Semester (winter/summer)	ECTS points	Hours
29	FRUIT-GROWING	Piotr Chełpiński	winter/summer	5	45
30	FUNDAMENTALS OF SOIL SCIENCE WITH ELEMENTS OF SOIL CARTOGRAPHY	Marek Podlasiński	winter/summer	5	50
31	GENETICALLY MODIFIED CROPS	Miłosz Smolik	winter/summer	3	23
32	GEOGRAPHIC INFORMATION SYSTEMS FOR RENEWABLE ENERGY ANALYSIS	Marek Podlasiński	winter/summer	5	45
33	GEOGRAPHIC INFORMATION SYSTEMS IN ENVIRONMENT PROTECTION AND SPATIAL PLANNING	Marek Podlasiński	winter/summer	5	45
34	GROWING OF ALTERNATIVE PLANT SPECIES	Marek Bury	winter/summer	4	30
35	INTEGRATED WEED CONTROL METHODS	Marek Bury	winter/summer	4	30
36	LANDSCAPE DESIGN	Magdalena Rzeszotarska-Pałka	summer	6	60
37	LIFE CYCLE ASSESMENT	Małgorzata Gałczyńska	winter/summer	4	30
38	LIQUID BIOFUELS	Małgorzata Hawrot-Paw	winter/summer	3	30
39	MATHEMATICAL MODELING	Arkadiusz Telesiński	winter/summer	5	40
40	MATHS	Arkadiusz Telesiński	winter/summer	5	45
41	MEDICINAL AND AROMATIC PLANTS	Kamila Bojko	winter/summer	5	45
42	MICROBIOLOGICAL TRANSFORMATION OF BIOMASS	Małgorzata Hawrot-Paw	winter/summer	3	30
43	MICROBIOLOGY	Krystyna Cybulska	winter/summer	4	30
44	MOLECULAR BIOLOGY	Piotr Masojć	winter/summer	6	60
45	MOLECULAR DIAGNOSTICS OF CULTIVATED PLANTS	Paweł Milczarski	winter/summer	3	30
46	MOLECULAR GENETICS OF PLANTS	Piotr Masojć	winter/summer	6	60
47	NATURAL ANTIOXIDANTS IN HORTICULTURAL CROPS	Arkadiusz Telesiński	winter/summer	4	30
48	NON-AGRICULTURAL SOURCES OF BIOMASS	Grzegorz Jarnuszewski	winter/summer	1	12
49	NUTZPFLANZEN DER TROPEN UND SUBTROPEN	Marek Bury	winter/summer	4	30
50	ORNAMENTAL PLANTS	Agnieszka Zawadzińska	winter/summer	6	60
51	ORNAMENTAL PLANTS IN THE WORLD	Agnieszka Zawadzińska	winter/summer	3	30
52	ORNAMENTAL POT PLANTS	Agnieszka Zawadzińska	winter/summer	3	30
53	PHOTOGRAPHY	Ewa Miśkiewicz-Żebrowska	winter/summer	3	30
54	PHYTOREMEDIATION POTENTIAL OF AQUATIC PLANTS	Małgorzata Gałczyńska	winter/summer	6	60
55	PLANT PHYSIOLOGY	Jacek Wróbel	winter/summer	5	40
56	PLANT TISSUE CULTURES	Danuta Kulpa	winter/summer	6	60

	Course title	Person responsible for the course	Semester (winter/summer)	ECTS points	Hours
57	POSTHARVEST BIOLOGY AND TECHNOLOGY OF FRUITS AND VEGETABLES	Kamila Bojko	winter/summer	5	45
58	PRESENTATION TECHNIQUES	Ewa Miśkiewicz-Żebrowska	winter/summer	3	30
59	PRINCIPLES OF PLANT BREEDING	Stefan Stojałowski	winter/summer	5	40
60	PROCESSING TECHNOLOGIES OF HERBAL PLANTS	Kamila Bojko	winter/summer	5	45
61	PROCESSING TECHNOLOGIES OF WASTE FOR ENERGY PRODUCTION	Grzegorz Jarnuszewski	winter/summer	3	14
62	PRODUCTION AND THE USE OF SOLID BIOFUELS	Marek Rynkiewicz	winter/summer	3	22
63	QUALITY ASSESSMENT OF SELECTED HORTICULTURAL CROPS	Kamila Bojko	winter/summer	4	30
64	RURAL LANDSCAPE	Magdalena Rzeszotarska-Pałka	summer	3	30
65	SELECTION AND USE OF ORNAMENTAL PLANTS IN THEMATIC GARDENS	Agnieszka Zawadzińska	winter/summer	4	30
66	URBAN LANDSCAPE	Eliza Sochacka-Sutkowska	winter/summer	3	30
67	WATER AND WASTWATER TREATMENT	Hanna Siwek	winter/summer	3	25
68	WATER CHEMISTRY	Hanna Siwek	winter/summer	4	30
69	БИЛКАРСТВО (BILKARSTVO)	Dorota Jadczak	winter/summer	4	30
70	ЗЕЛЕНЧУКОПРОИЗВОДСТВО - 2 ЧАСТ (ZELENCUKOPROIZVODSTVO CAST 2.)	Dorota Jadczak	winter/summer	5	45
71	ЗЕЛЕНЧУКОПРОИЗВОДСТВО - I ЧАСТ (ZELENCUKOPROIZVODSTVO CAST 1.)	Dorota Jadczak	winter/summer	4	30
72	ИНТЕГРИРАНО ПРОИЗВОДСТВО НА ЗЕЛЕНЧУЦИ И БИЛКИ (INTEGRIRANO PROIZVODSTVO NA ZELENCUCI I BILKI)	Dorota Jadczak	winter/summer	4	30
73	СЕЛЕКЦИЯ И СЕМЕПРОИЗВОДСТВО НА ЗЕЛЕНЧУКОВИТЕ КУЛТУРИ /SELEKCIYA I SEMEPROIZVODSTVO NA ZELENCUKOVITE KULTURI	Dorota Jadczak	winter/summer	5	45
74	СЪБИРАНЕ НА ДИВОРАСТЯЩИ БИЛКИ (SYBIRANE NA DIVORASTYASTI BILKI)	Dorota Jadczak	winter/summer	4	30

Course title	ABIOTIC AND BIOTIC STRESS IN PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Marcelina Krupa-Małkiewicz	**E-mail address to the person**	Marcelina.Krupa-Malkiewicz@zut.edu.pl
Course code (if applicable)	WKSiR-2-1	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40

Objectives of the course	Theoretical knowledge and practical skills of the students in the field of plant physiology The effect of the main abiotic factors on different organizational and structural levels of the plant organism will be reviewed The module will allow students to obtain deep knowledge of various research methods (greenhouse tests, in vitro culture) to obtain plant tolerant for abiotic stress
Entry requirements	The fundamental knowledge of genetics and plant physiology, basic knowledge of micropropagation
Course contents	During the practices students will train in vitro condition optimalization for selected plants (low and high temperatures, water, light stress, salinity) Student will acquire some practical skills for studying the different ways in which the plant responds to stress Students know how to work in laboratory group and know work safty regulations Students know how to preper the different kind of medium with addition of selectig factor Plant breeding for resistance - today and tomorrow The influence of the different stress factor (low and high temperaturs, water, light stress, salinity, pathogens) on the molecular, phisiological and biochemical levels of the plant organisms Use of various research methods (greenhouse, in vitro culture) to obtain plant tolerant for abiotic stress Use of genetic engineering and molecular biology to obtain plant resistance Presentations and discussions. Written exam
Assessment methods	Lecture Discussion laboratory written exam assessments of students presentations
Recommended readings	1. Ashraf M., Harris PJC, Abiotic stresses - plant resistance trough breeding and molecular approaches, Food Product Press Haworth Press, New York, 2005
Knowledge	student will gain a theoretical skills for the experimental design in in vitro culture
Skills	Student will train in vitro condition optimalization for selected plants. Student will acquire some practical skills for studying the different ways in which the plant respond to stress
Other social competences	Student know how to work in laboratory group and know work safty regulations

Course title	AGRICULTURAL BIOMASS PRODUCTION FOR ENERGY PURPOSES		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-2	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Getting to know the sources of agricultural biomass, getting to know cultivation technologies of special crops that can serve as "source of energy"		
Entry requirements	Botany, plant nutrition, plant physiology, soil science		
Course contents	Learning about cultivation methods (cultivation technologies) of species for biogas production (Sudan grass, sorghum, mallow), heat recovery (fast-growing tree species: willow, poplar) or heat and electric power generation (Jerusalem artichoke, Miscanthus, Sida), as well as bioethanol and biodiesel (rye, Triticale, rapeseed) Agricultural biomass production is primarily intended for crop technologies of plant species that are grown in agriculture and are not used for food production but can be grown as renewable raw materials for industry or as an energy source, e.g. in the form of biogas (Sudangras, Sorghum, sugar millet, mallow, cup plant), heat (fast-growing tree species: willow, poplar) or heat & electric energy (Jerusalem artichoke, miscanthus, sida), but also in the form of bioethanol and biodiesel (rye, triticale, rapeseed). In addition to cultivation technologies, other sources of biomass are also mentioned, which are produced as by-products or waste products in crop production (for example, straw). It is reported on the economic importance, botany (short characteristics), site conditions (soil and climatic conditions) and selected cultivation methods		
Assessment methods	Lecture, multimedia presentation written work (evidence of selected plant species cultivation or biomass production from agriculture) Evaluation of presentation / project		
Recommended readings	1. Camia A., Robert N., Jonsson R., Pilli, R., García-Condado S., López-Lozano R., van der Velde M., Ronzon T., Gurría P., M'Barek R., Tamosiunas S., Fiore G., Araujo R., Hoepffner N., Marelli L., Giuntoli J., Biomass production, supply, uses and flows in the European Union. First results from an integrated assessment, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-77237-5, doi:10.2760/539520, JRC109869 2. Team work, Biomass and agriculture. Sustainability, markets and policies., OECD Publications, Cedex, Paris, 2004, 572 p. 3. Team work, Energy from field energy crops – handbook for energy producers., Publisher Jyväskylä Innovation Oy. Finland, 2009 4. Espinoza L., Kelly J., Grain sorghum production handbook, COOPERATIVE EXTENSION SERVICE, University of Arkansas, Litlle Rock, 2003, https://www.uaex.edu/publications/pdf/mp297/MP297.pdf		
Knowledge	The student will have knowledge of the growing technologies of plant species grown as biomass source for energy production, e.g. in the form of biogas, heat and / or heat & Electric energy and in the form of bioethanol & biodiesel		
Skills	The student will have the knowledge about plant species for biomass production and about their cultivation method		
Other social competences	The student will have skills to recognize the suitability of selected plant species for biomass production		

Course title	AGROPHYSICS		
Level of course	second cycle		
Teaching method	lecture		
Person responsible for the course	Romualda Bejger	**E-mail address to the person**	Romualda.Bejger@zut.edu.pl
Course code (if applicable)	WKSiR-2-7	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	1	**Hours per semester**	20
Objectives of the course	Presentation of the most important concepts, principles, laws and theories of physics to the extent necessary for correct understanding and interpretation of processes occurring in nature. Developing students' active attitude towards the acquired knowledge, in particular in terms of using it for independent interpretation of the observed phenomena and processes.		
Entry requirements	basic of physics, basic of general ghemistry, physiology of plants		
Course contents	Agrophysics - subject, scope and research objects Soil–Water–Plant–Atmosphere Relationship Influence of physical and physicochemical properties of soils on the growth, yield and fertilization efficiency of crops. Physical and technological properties of plant materials. Mechanical properties of cereal grains. Using of luminescence methods in soil and plant studies. Statistical methods in agrophysics.		
Assessment methods	lecture/multi-media presentation discussion assessmant of the participation in the discussion written exam - test		
Recommended readings	1. J. Gliński, J. Horabik, J. Lipiec, W.E.H. Blum, J. de Baerdemaeker, Ch. W. Finkl, R. Horn, Y. Pachepsky, E. V. Shein, K. Konstankiewicz, Encyclopedia of Agrophysics - Encyclopedia of Earth Sciences Series, Springer, The Netherlands, 2011 2. H. Willard, L. Merritt, J. Dean, Instrumental Methods of Analysis, Wadsworth Publishing Company, New York, 1988		
Knowledge	Student describes and explains the physical nature of phenomena based on the laws of physics. Student defines the basic and derived physical parameters and units according to SI.		
Skills	Student is able to distinguish between the physical phenomena, the laws of physics, physical parameters, units.		
Other social competences	Student demostrates understanding of the physical phenomena occuring in the nature. Student is aware of the need of self-eductaion.		

Course title	ALTERNATIVE QUELLEN DER ENERGIE IN DER LANDWIRTSCHAFT		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-3	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	german
Hours per week	2	**Hours per semester**	30
Objectives of the course	Bei erfolgreichem Abschluss des Faches wird der Student in der Lage sein: - gute Kenntnisse von alternative Quellen der Energie in der Landwirtschaft und von der Bedeutung von gezielten Anbau von Energiepflanzen und Biomasseproduktion in der Energiewirtschaft Europas und Polens haben, - diskutieren über die gezielten Biomasseproduktion und Anbau von Energiepflanzen im Zusammenhang mit dem derzeit besten Verfahren auf dem Markt. - beschreiben eine Pflanzenanbau-technologie und Pflanzenschutz-Programm der verschiedenen biomasseliefernden Pflanzen und Rohstoffen		
Entry requirements	Botanik, Pflanzenernährung, Pflanzenphysiologie, Bodenkunde		
Course contents	Detaillierte Charakterisierung der wichtigsten Rohstoffe für Biomasse- und Biogasnutzung und Biokraftstoffherstellung. Ein- und zweijährige Energiepflanzenarten - Artencharakterisierung, Anforderungen an Klima und Standort (Bodenverhältnisse), agrotechnische Massnahmen zum Anbau und Pflege. Erträge, Qualität der Endprodukten. Mehrjährige Pflanzenarten - Artencharakterisierung, Anforderungen an Klima und Standort (Bodenverhältnisse), agrotechnische Massnahmen zum Anbau und Pflege. Erträge, Qualität der Endprodukten. Kennenlernen der Quellen der Energie aus der Landwirtschaft, Quellen der Biomasse und Bedeutung der Biomasseproduktion auf den landwirtschaftlichen Nutzflächen und Abfällen aus der landwirtschaftlichen Produktion. Kennenlernen von Anbautechnologien von Pflanzenarten gedacht, die als alternative Energie- und Biomassequelle genutzt oder angebaut werden können, z.B. in Form von Biogas (Sorghumhirse, Sudangras, Mais), Wärme/ Holzgas (schnell wachsende Baumarten wie Paulownia) oder Wärme & Elektroenergie (mehrjährige Pflanzenarten wie Silphium, Sida), aber auch in Form von Bioethanol & Biodiesel (Getreide, ZR, Ölfrüchte). Es wird über die wirtschaftliche Bedeutung, Botanik (kurze Charakteristik), Standortbedingungen (Boden- und Klimaverhältnisse) und gewählte Anbauverfahren berichtet.		
Assessment methods	Vorlesung / Multi-media Präsentationen Erkennen der wichtigsten alternativen Quellen für Biomasse- und Biogasnutzung und Biokraftstoffherstellung Beurteilung von Präsentation / Projektes		
Recommended readings	1. Diepenbrock W., Fischbeck G., Heyland K-U., Spezieller Pflanzenbau, Ulmer Verlag, Stuttgart, 2011 2. Aigner, J., Altenburger J., Übersicht über den Anbau von Alternativpflanzen (Hanf). V: Pflanzenbau., Österreichischer Agrarverlag, Wien, 1997 3. SCHUSTER, W. H.,, Ölpflanzen in Europa, DLG-Verlag, Frankfurt/Main, 1992 4. Udelgard Korber-Grohne, Nutzpflanzen in Deutschland. Kulturgeschichte und Biologie, Verlag Konrad Theis, Stuttgart., 2000 5. Ściążko M., Zuwała J. i Pronobis M., Współspalanie biomasy i paliw alternatywnych w energetyce, Wydawnictwo IChPW i Politechniki Śląskiej, Zabrze-Gliwice, 2007		
Knowledge	Die/der Studierende kennt die alternativen Quellen der Energie in der Landwirtschaft und sie/er kennt die Bedeutung der Biomasse und die Bedeutung des gezielten Anbau von Energiepflanzenarten		
Skills	Die/der Studierende kann die entsprechenden alternativen Quellen der Energie in der LW beschreiben und über die gezielten Biomasseproduktion diskutieren		
Other social competences	Die /der Studierende zeigt ein Verständnis der grundlegenden Prozesse, die es ermöglichen, Energie für Wärme und Kraft zu gewinnen und zu umwandeln, erkennt grundlegende Arten der Energie aus der LW und kann die Möglichkeiten der Energiegewinnung aus alternativen Quellen (z.B. aus Biomasse) zu nennen		

Course title	ANBAU VON ALTERNATIV-PFLANZENARTEN		
Level of course	second cycle		
Teaching method	lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-4	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	german
Hours per week	2	**Hours per semester**	30
Objectives of the course	Die Studierenden erwerben detaillierte Kenntnisse über die bedeutendsten Nutzpflanzenarten, die Qualitätsanforderungen an ihre Produkte und ihre pflanzenbauliche Produktionstechnik, schwerpunktmäßig für ackerbaulich genutzte Arten in gemäßigten Klimazonen		
Entry requirements	Grundlegende Kenntnisse in Botanik, Pflanzenphysiologie und Pflanzenbau		
Course contents	Anbau von Alternativpflanzen ist den Anbautechnologien von Pflanzenarten gedacht, die zur Nahrungsproduktion und als Rohstoffe für Kosmetik-Industrie, z.B. Zuckerhirse, Buchweizen, Quinoa, Amaranthus, Öllein, Borretsch, Russische Löwenzahn, Leindotter, Wunderbaum) Auch Färbepflanzen (Krapp, Resede, Waid). Es wird über die wirtschaftliche Bedeutung, Botanik (kurze Charakteristik), Standortbedingungen (Boden- und Klimaverhältnisse) und gewählte Anbauverfahren berichtet		
Assessment methods	Vorlesung / Multi-media Präsentationen Erkennung von einzelnen Arten Beurteilung von Präsentation / Projektes		
Recommended readings	1. Diepenbrock W., Fischbeck G., Heyland K-U., Knauer N., Spezieller Pflanzenbau, Eugen Ulmer Verlag, Stuttgart, 1999 2. SCHUSTER, W. H., Ölpflanzen in Europa, DLG-Verlag, Frankfurt/Main, 1992 3. KÖRBER-GROHNE U., Hülsenfrüchte, unsere Quelle fürs pflanzliche Eiweiß, Verlag Konrad Theis, Stuttgart, 1987, In: Nutzpflanzen in Deutschland. Kulturgeschichte und Biologie. 97-139 4. Aigner, J., Altenburger J., Übersicht über den Anbau von Alternativpflanzen (Hanf). V: Pflanzenbau, Österreichischer Agrarverlag, Wien, 1997		
Knowledge	Der Student hat Kenntnis von der Bedeutung von Alternativpflanzenarten in der Wirtschaft. Der Student kennt die Anbautechnik von Alternaticpflanzenarten		
Skills	Der Student ist in der Lage, die Grundsätze und die Bedeutung der Produktion von Alternativpflanzenarten aufzuzählen und kann die geeignete Methode und Technologie des Anbaus wählen, die die Rentabilität der Produktion garantiert		
Other social competences	Der Studierende ist bewusst der Bedeutung und des Verständnisses der agrotechnischen Aspekte des Ingenieurwesens, einschließlich seiner Auswirkungen auf die Umwelt, und der damit verbundenen Entscheidungsverantwortung bewusst		

Course title	AQUATIC PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Małgorzata Gałczyńska	**E-mail address to the person**	Malgorzata.Galczynska@zut.edu.pl
Course code (if applicable)	WKSiR-2-5	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	The goals of this course are: 1) to become familiar with the habitats where aquatic plants are commonly found, 2) to understand macrophyte methods to assess the trophic states of water bodies in Europe 3) to understand the functioning of nutrient cycles in aquatic systems, 4) to understand the concepts of restoration and constructed wetlands, 5) become familiar with aquatic nuisance plant species and their role in the environment, 6) become familiar with the primary literature (scientific journals and reference books) in this field. The lab portion will focus on use of small ecosystems for study, short field trips to local river and lake, and familiarization with field instruments and water testing kits.		
Entry requirements	Basic knowledge of general chemistry Basic knowledge of environmental chemistry		
Course contents	Identification of some aquatic plants during field trip Measurement of pH Determination of dissolved oxygen in water Determination of nitrogen and phosphorus compounds in water Statictical analyses Definition of aquatic plants. Morphological types of hydrophytes. Morphological and physiological adaptation of aquatic plants Role of aquatic plants in monitoring and assessment of water quality Nutrient cycles in aquatic systems Role of aquatic plants in environmental clean-up. Constructed wetlands (trophic interactions in macrophyte beds, types of contaminants commonly reported in wastewaters, mechanism of removal of contaminants, potential of constructed wetlands in cleaning domestic and industrial wastewaters, stormwater treatment with floating aquatic plants, growth factors of aquatic plants, future aspects of this technology). Aquatic plant restoration Aquatic weeds and control of aquatic vegetation		
Assessment methods	Multimedia presentations Discussion Laboratory exercises Assessment of the homework assignments Essay - mitigation proposal for constructed urban aquatic habitats Reports of water analysis and determination of aquatic plant		
Recommended readings	1. Bhupinder Dhir, Phytoremediation: role of aquatic plants in environmental clean-up., Springer, 2013 2. Craig S. Campbell, Michael Ogden, Constructed Wetlands in the Sustainable Landscape, 1999 3. Jan Vymazal, 3. The role of natural and constructed wetlands in nutrient cycling and retention on the landscape, 2014		
Knowledge	Student gains theoretical and practical knowledge related to the circulation of elements in nature and their migration in the soil-water-plant system		
Skills	Student gains skills self-assessment of water quality by macrophyte methods and describes some aquatic plants, that are used in constructed wetlands. Moreover, he/she can do chemical analysis of water in hydroponic culture in environmental laboratories.		
Other social competences	Student demonstrates understanding of phenomena occurring in the aquatic ecosystem. Student sees the need of self-development and further education. Furthermore, every student organizes and leads researches in a team. Students are responsible for ensured equipment.		

Course title	ARABLE LAND MANAGEMENT SYSTEMS		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-6	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Getting to know the the present farming systems on arable land (conventional, integrated and ecological system and permaculture)		
Entry requirements	history of agriculture, botanic, crop rotation, plant cultivation		
Course contents	Optimization of the physico-chemical properties of soils in protection against environmental degradation caused by agricultural activities. Sources and role of organic mass in protection of soil production potential. Projects of crop rotation and selection of agrotechnics in specific habitat conditions and management system, taking into account impact on the soil environment Management systems and environmental biodiversity. Characteristics of modern agricultural systems. Conventional, integrated and ecological farming in the world in the EU and Poland - development perspectives. Permaculture. Soil cultivation, fertilization and soil fertility depending on the management system. Plant protection rules depending on the management method. Legal regulations and organic farming attestation. The quality of agricultural produce depending on the manner of farming - the organic food market.		
Assessment methods	Lectures Presentations (multi media) written work or prepared presentation or project Evaluation of presentation / of the project		
Recommended readings	1. Gołaś Z., Development of organic farming in Poland., J. Agribus. Rural Development, 4(42), 533–543., 2016, DOI: 10.17306/JARD.2016.80 2. David W Archer, Jose G Franco, Jonathan J Halvorson, and Krishna P Pokharel, Integrated Farming Systems, Elsevier Inc. USDA Agricultural Research Service, Northern Great, 2018 3. David Pimentel, Paul Hepperly, James Hanson, Rita Seidel, David Douds, Organic and Conventional Farming Systems: Environmental and Economic Issues., Cornell University, Ithaca, NY, USA, 2005 4. Bill Mollison, PERMACULTURE A Designers Manual, A Tagari Publication, Sisters Creek, Tyalgum, Australia, 2002, second edition, https://docer.pl/doc/n1n1xns ; 601 p. 5. Bill Mollison, Introduction to permaculture, Yankee Permaculture, Sparr, Florida, USA, 2001, ninth edition		
Knowledge	The student will have knowledge of the present farming systems on arable land (conventional, integrated and ecological) and could explain differences between the systems and discuss the pros and cons (advantages and disadvantages)		
Skills	The student will have the skill for characteristics of modern agricultural systems and the student will have skills to recognize them		
Other social competences	The student will have competence to recognize how farmers adjust their farming and life according to ownership, labour, mechanizations, perceptions of climate change etc.		

Course title	BASICS OF WATER MANAGEMENT IN THE CATCHMENT		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Grzegorz Jarnuszewski	**E-mail address to the person**	Grzegorz.Jarnuszewski@zut.edu.pl
Course code (if applicable)	WKSiR-2-8	**ECTS points**	2
Semester	winter/summer	**Language of instruction**	english
Hours per week	0	**Hours per semester**	14
Objectives of the course	Knowlegde of water management, the roles of water resources and stakeholders in the catchment. Ability to assess the priority use of water in the catchment and assessment of the amount of water available.		
Entry requirements	Fundamental knowledge of hydrology		
Course contents	Watersheed area, topographic and underground catchment Water balance in watersheed Disposal of water resources Agricultural catchment Planning in water management Basics of hydrology Water cycle in the catchment Assesment methods of amount and water quality Water management		
Assessment methods	Lectures/multimedia presentation Laboratories/case method, discussion elaboartion test		
Recommended readings	1. World Meteorological Organization, Guide to Hydrological Practices Volume I, WMO, Geneva, Switzerland, 2003 2. Loucks D.P. and Van BEEK E., Water Resources System Planning and Management, Unite Nations Educational, Scientific and Cultural Organization, Turin, Italy, 2005 3. Edwards P.J, Wiliard K.W.J., Schoonover J.E., Fundamentals of Watershed Hydrology, Journal of Contemporary Water Research & Education, 2015, 154		
Knowledge	Student has knowledge of water management, water resources the roles of water resources and stakeholders in the catchment.		
Skills	Ability to assess the priority use of water in the catchment and assessment of the amount of water available.		
Other social competences	Student is aware of the current need to adapt water management elements to the needs of users and the necessity of sustainable water management in the catchment.		

Course title	BIOCHEMISTRY		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Arkadiusz Telesiński	**E-mail address to the person**	Arkadiusz.Telesinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-9	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	The aim of Biochemistry is to understand life in molecular terms. The goal this course is possibility to describe the structure, organization, and functions of living matter in molecular terms. What are the chemical structures of the components of living matter? How do the interactions of these components give rise to organized supramolecular structures? How does living matter extract energy from its surroundings in order to remain alive? How are chemical reactions controlled inside living cells? There are the kinds of questions being answered by someone have been finished this course.The aim of Biochemistry is to understand life in molecular terms. The goal this course is possibility to describe the structure, organization, and functions of living matter in molecular terms. What are the chemical structures of the components of living matter? How do the interactions of these components give rise to organized supramolecular structures? How does living matter extract energy from its surroundings in order to remain alive? How are chemical reactions controlled inside living cells? There are the kinds of questions being answered by someone have been finished this course.		
Entry requirements	To understand Biochemistry, one must first study basic chemistry and cell biology. In addition, an understanding of the basic thermodynamic principles is essential for learning how plants derive energy from sunlight and how animals derive energy from food.		
Course contents	Characteristic reactions of amino acids Characteristic reactions of proteins Characteristic reactions of nucleic acids Characteristic reactions of carbohydrates Characteristic reactions of lipids Determination of some oxidoreductases and hydrolases Determination of some vitamins Determination of plant secondary metatabolites: polyphenols and flavonoids Determination of plant secondary metabolites: alkaloids Two types nucleic acids (DNA and RNA), – propertis and functions nucleotides and nucleic acids (replication, transcription, translation). Proteins – (amino Acids, peptides and the peptide bonds, polipeptides). The primary level of protein structure. The three-dimensional structure of proteins. Carbohydrates (monosacharides, oligosacharides, polysacharides). Lipids, membranes, and cellular transport. Enzymes: biological catalysts (vitamins as procoenzymes, metals as enzymatic cofactors, classification of protein enzymes, regulation of enzyme activity). Introduction to metabolism. Carbohydrate metabolism I. Anaerobic processes in generating metabolic energy (Glycolysis – reactions and regulation). Metabolic fates of pyruvate. Oxidative processes: Citric Acid Cycle and Pentose Phosphate Pathway. Electron transport, oxidative phosphorylation, and oxygen metabolism. Carbohydrate metabolism II. Biosynthesis (gluconeogenesis, glikogen biosynthesis). Photosyntesis. Lipid metabolism: Fatty acids, triacylglicerols, and lipoproteins. Plant secondary metabolism		
Assessment methods	Lectures Laboratories Pass laboratory conspects Tests		
Recommended readings	1. Mathews C.K., van Holde K.E., Ahern K.G., Biochemistry 2. Stryer L., Biochemistry 3. Nelson D.L., Cox M.M., Lehninger Principles of Biochemistry, Fourth		
Knowledge	The student knows the structure of macromolecules and can discuss their metabolism		
Skills	Student uses basic biochemical concepts and can assay of macromolecules		
Other social competences	The student can work in a team and demonstrate the ability to work in the laboratory division		

Course title	BIOMASSEPRODUKTION ZUR ENERGIEGEWINNUNG		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-10	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	german
Hours per week	2	**Hours per semester**	30
Objectives of the course	Kennenlernen der Quellen von Agro-Biomasse, Kennenlernen von Anbautechnologien von speziellen Kulturen, die als „Energiequelle“ dienen koennen		
Entry requirements	Botanik, Pflanzenernährung, Pflanzenphysiologie, Bodenkunde		
Course contents	Kennenlernen von Anbauverfahren (Anbautechnologien) von Arten zur Biogasgewinnung (Sudangras, Zuckerhirse, Malve), Wärmegewinnung (schnellwachsende Baumarten: Weide, Pappeln) oder Wärme & Elektroenergiegewinnung (Topinambur, Miscanthus, Sida), aber auch in Form von Bioethanol & Biodiesel (Roggen, Triticale, Raps) Biomasseproduktion ist v.a. den Anbautechnologien von Pflanzenarten gedacht, die in der Landwirtschaft angebaut werden und nicht zur Nahrungsproduktion dienen, sondern als nachwachsende Rohstoffe für Industrie oder als Energiequelle angebaut werden können, z.B. in Form von Biogas (Sudangras, Zuckerhirse, Malve), Wärme (schnellwachsende Baumarten: Weide, Pappeln) oder Wärme & Elektroenergie (Topinambur, Miscanthus, Sida), aber auch in Form von Bioethanol & Biodiesel (Roggen, Triticale, Raps). Ausser Anbautechnologien werden auch andere Biomassequellen angesprochen, die bei der Pflanzenproduktion als Neben- oder Abfallprodukte entstehen (z.B. Stroh). Es wird über die wirtschaftliche Bedeutung, Botanik (kurze Charakteristik), Standortbedingungen (Boden- und Klimaverhältnisse) und gewählte Anbauverfahren berichtet		
Assessment methods	Vorlesungen, multimediale Praesentationen schriftige Arbeit (Beleg zur ausgewaehlten Pflanzenart-anbau oder zu Biomassegewinnung aus der Landwirtschaft) Vorbereitung von Präsentation / Projektes		
Recommended readings	1. Aigner, J., J., Altenburger, Übersicht über den Anbau von Alternativpflanzen (Hanf). V: Pflanzenbau, Österreichischer agrarverlag, Wien, 1997 2. SCHUSTER, W. H., Ölpflanzen in Europa, DLG-Verlag, Frankfurt/Main, 1992 3. Viele Autoren(praca zbiorowa), Nutzpflanzen in Deutschland. Kulturgeschichte und Biologie, Verlag Konrad Theis, Stuttgart, 1998		
Knowledge	Die/ der Studierende wird ein Wissen ueber die Anbautechnologien von Pflanzenarten haben, die als Biomassequelle zur Energiegewinnung angebaut werden, z.B. in Form von Biogas, Wärme und/oder Wärme & Elektroenergie und in Form von Bioethanol & Biodiesel		
Skills	Die/ der Studierende wird die Kenntnisse ueber Pflanzenarten zur Biomasseproduktion haben und ueber deren Anbauverfahren		
Other social competences	Die/ der Studierende wird Faehigkeiten besitzen zur Erkennen der Eignung von gewaehlten Pflanzenarten zur Biomasseproduktion		

Course title	BIOTECHNOLOGY FOR ENVIRONMENT PROTECTION		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Masojć	**E-mail address to the person**	Piotr.Masojc@zut.edu.pl
Course code (if applicable)	WKSiR-2-11	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Presentation of modern methods of plant biotechnology and their application in environment protection		
Entry requirements	Basic molecular biology, plant breeding.		
Course contents	Breeding methods for improving environment traits of plants Molecular breeding Methods of in vitro culture Methods of GMO generation Useful traits modified by genetic engineering Algae for renewable biomass and energy production Plants for renewable biomass and energy production Selecting plants for sustainable agriculture with decreased fertilizers and pesticide doses Selecting plants with lower energy input for cultivation Types of environmental stresses for plants and their response strategies Plants better adjusted to climate change Classic breeding and biotechnological methods to improve plant performance in stress conditions Phytoremediation as an effective method of soil and water protection Genetically modified plants for environment protection		
Assessment methods	laboratory lecture practical exam written exam		
Recommended readings	1. Jeżowski S., Wojciechowicz M.K., Zenkteler E., Alternative plants for sustainable agriculture, Polish Academy of Science, Poznań, 2006 2. Razdan M., Introduction of plant tissue culture, Science Publisher, 2003		
Knowledge	Students will gain knowledge on various methods of producing plants tolerant to environmental stresses and giving high biomass production		
Skills	Students will be able to recognize plant species and methods for their improvement in respect to environmental challenges		
Other social competences	Students will be aware of possibilities to utilize modern biotechnology methods for improving plants as a renewable recources for environment protection		

Course title	BIOTECHNOLOGY IN AGRICULTURE		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Masojć	**E-mail address to the person**	Piotr.Masojc@zut.edu.pl
Course code (if applicable)	WKSiR-2-12	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Presentation of modern methods of plant biotechnology and their application in agriculture.		
Entry requirements	Basic molecular biology, plant breeding.		
Course contents	Gene clonnig technology. Preparation of gene constructs, methods of transformation and identification of positive clones. The use of bacterial vectors and plasmid cloning. Purification of plasmids, sequencing of the gene fragment and characterization of the results. Identification of GMO in some food products. Isolation of DNA from the food products, the amplification using the reference PCR. Detection of traces of GMO and characterization results. Genetic structure of cultivated crops Methods of genome research. In vitro cultures of plants. Methods of genetic engineering. Methods of generating transgenic plants (GMO) Useful traits modified by genetic engineering. Commercialy available GMO in agriculture. Molecular breeding and farming Biosafety aspects of GMO production. Methods of GMO detection in commercial products		
Assessment methods	lecture laboratory practical exam written exam		
Recommended readings	1. Slater A., Scott N., Fowler M., Plant Biotechnology. The Genetic manipulation of plants., Oxford University Press Inc, New York, 2003 2. Dixon R.A., Gonzales R.A., Plant Cell Culture, IRL Press, Oxford, New York, Tokyo, 1994		
Knowledge	students will gain knowledge in methods of modern biotechnology to ascertain higher yield and quality of cultivated plants.		
Skills	student will be able to perform the basic techniques of cloning, sequencing and detection of transgenes.		
Other social competences	Student will know how to work in laboratory group and know work safety regulation in GMO lab .		

Course title	BIOTECHNOLOGY OF HERBAL PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Marcelina Krupa-Małkiewicz	**E-mail address to the person**	Marcelina.Krupa-Malkiewicz@zut.edu.pl
Course code (if applicable)	WKSiR-2-13	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40

Objectives of the course	Theoretical knowledge and practical skills of the students in the field of plant physiology Development of herbal medicinal products in a pharmaceutical technology
Entry requirements	The fundamental knowledge of genetics and plant physiology, basic knowledge of micropropagation
Course contents	students will gain a practical skills for the experimental design in in vitro culture (conditions, plant material, medium composition) optimalization in vitro culture conditions for selected herbal plants students know how to preper the different kind of medium with addition of selected plant growth regulators students know how to work in laboratory group and know safty regulations An overview to the development of herbal medicinal productsin a pharmaceutical technology Classification of herbal remedies A characterization and application of herbal products like bioflavonoids, antioxidative compounds and plant hormones Methods of the biosynthesis enhancing primary and secondary plant metabolites production in callus culture In vitro culture and root culture of selected herbal plants A biotechnology of herbal wellness substances by using bioreactors Presentations and disscussions. Written exam
Assessment methods	lecture disscussion laboratory written exam assessments of students presentations
Recommended readings	1. Razdan M, Introduction of plant tissue culture, Science Publisher, 2003
Knowledge	Students will gain a theoretical skills for the experimental design in in vitro culture
Skills	during the practis student will train in vitro condition opitmalization for selected herbal plants
Other social competences	student know how to work in laboratory group and know work safty regulations

Course title	CROPS OF THE TROPICS AND SUBTROPICS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-14	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Students acquire detailed knowledge of the most important crop species, the quality requirements for their products and their crop production techniques, with a focus on arable crops in tropical and subtropical climates		
Entry requirements	Basic knowledge of botany, plant physiology and plant cultivation		
Course contents	The short description and botany and the general idea of plants originating from tropical countries (corn, sorghum, amaranthus, sunflower, potatoes, hemp) or cultivated in tropics and subtropics (rice, quinoa, cotton, manioc, oil palm, sugar cane, etc.) The content includes economic importance, site conditions (soil and climatic conditions) and the general cultivation practices of plants originating in tropical countries and grown in Europe (maize, sorghum, amaranthus, sunflower, potatoes, hemp) and species selected by the student reports that are grown in the tropics and subtropics. As an example, here can be cultivation of rice, quinoa, cotton, manioc, oil palm, coffee, cocoa, tea and others. to be named		
Assessment methods	Lecture / Multi-media presentations indentification of crops Preparation of presentation / project Evaluation of presentation / of the project		
Recommended readings	1. du Plessis J., Maize production, Department of Agriculture, Pretoria South Africa, 2011, https://www.arc.agric.za/arc-gci/Fact%20Sheets%20Library/Maize%20Production.pdf 2. Team work, Farmer’s Handbook on basic agriculture, Desai Fruits & Vegetables Pvt. Ltd., Gujarat, India, 2015, https://www.manage.gov.in/publications/farmerbook.pdf 3. Team work, Industrial Oil Crops., Editors: Thomas McKeon Douglas Hayes David Hildebrand Randall Weselake., eBook ISBN: 9780128053850. pp. 474, 2016, 1st Edition		
Knowledge	The student has knowledge of the importance of crops from the tropics and subtropics in the global economy and in the economy of Europe (Poland), describes the tropical plant species grown in Europe		
Skills	The student is able to enumerate the principles and importance of the production of crop species of the tropics and subtropics and can choose the appropriate method and technology of cultivation that guarantees the profitability of the production		
Other social competences	The student is aware of the significance and the Understanding of the agrotechnical aspects of the engineering, including its impact on the environment		

Course title	CULTIVATION TECHNOLOGY OF CEREALS AND LEGUMES		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / field course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-74	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	65
Objectives of the course	Students acquire detailed knowledge of the most important crop species, the quality requirements for their products and their crop cultivation techniques		
Entry requirements	Basic knowledge in botany, plant physiology and arable farming		
Course contents	Botany (short characteristics), choice of varieties and methods of sowing, fertilization, indirect and direct control of microbial and pest control, establishment and management of populations of the most important crops (cereals including maize, and grain and perennial legumes. Working with fresh and dried plant material, identification of individual species, knowledge of the seeds, yield structure elements, botanical and plant-based characteristics of important cereals and legume fruits Vegetation-related surveys (population density, development stages of cereals and legumes, yield share estimate) in a practice (Agricultural Research Station in Lipnik), on the basis of which the management claims and measures for agritechnic (agricultural engineering) are estimated Cultivation technology of cereals and legumes (butterflies) includes economic importance, site conditions (soil and climatic conditions) and the detailed cultivation practices (with crop production, stock management, harvest) of all cereals including corn, millet and buckwheat and product quality. Cultivation of pulses and perennial legumes cultivated in Poland and Europe.		
Assessment methods	Lecture / Multi- media presentations Demonstration - showing fresh and dried plant materials Identification (detection) of individual plant species Assessment of presentations / projects written exam (Test)		
Recommended readings	1. Rudel T., Schneider L., Uriarte M. et all., Agricultural intensification and changes in cultivated areas, 1970–2005, PNAS, editor William C. Clark, Harvard University, Cambridge, 2009, vol. 106, 49, 2. Shekara P.C., Kumar A., Balasubramani N, Chaudhary B.C.,, Farmer's handbook on basic agriculture, Desai Fruits & Vegetables Pvt. Ltd., Gujarat, 2015, https://www.manage.gov.in/publications/farmerbook.pdf 3. AHDB (group work), Wheat growth guide, Agriculture and Horticulture Development Board, Warwickshire, 2017, https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/Wheat%20growth% 4. AHDB (group work), Barley growth guide, Agriculture and Horticulture Development Board, Warwickshire, 2017, https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/Barley%20growth%2		
Knowledge	The student has knowledge of the importance of cereals and legumes in the economy of Europe and Poland, describes the types of cereals and legumes grown in Europe / world. The student knows the cultivation technique of cereals and legumes. The student knows the ways of development (trends, directions of future use), processing and correct use of the individual plant species		
Skills	The student is able to enumerate the principles and importance of the production of cereals and legumes and can choose the appropriate method and technology of cultivation that will achieve the profitability of the production and will not be detrimental to the environment. The student has the ability to correctly classify cereals and legumes. Indicates the yield potential of individual plant species.		
Other social competences	The student is aware of the importance and understanding of the agrotechnical aspects of engineering, including its effects on the environment, and the associated decision-making responsibility		

Course title	CULTIVATION TECHNOLOGY OF ENERGY CROPS		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-15	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	The purpose of this course is to gain sufficient knowledge and experience about using areas and cultivation techniques of energy crops		
Entry requirements	Student has basic knowledge of crops cultivation and botany and fertilization		
Course contents	Introduction, the importance of energy crops. Annual versus perennial crops, Crops with C3 or C4 photosynthesis, Choice of crop in relation to soil type and climate conditions, Cultivation, harvest and plant protection of dedicated energy crops compared to conventional agricultural crops, Biomass quality including content of sugars, starch, inulin, cellulose, lignin, oil and protein, Important crop qualities for storage, fermentation, combustion and oil extraction. Nutrient cycles and losses Annual and biennial crops – characteristic of the species, cultivars, requirements, cultivation and the use. Perennial herbaceous plants – characteristic of the species, cultivars and clones, requirements, cultivation and the use. Perennial woody crops (fast growing trees and shrubs) – characteristic of the species, cultivars and clones, requirements, cultivation and the use. The cultivation technologies (Growing techniques of crops) of plant species which can not be used for food production, but can be cultivated as an energy source, e.g. in the form of biofuels like biodiesel, bioethanol, biomethanol (corn, cereals, canola, linseed, safflower, sunflower, sugar beet), in form of biogas (corn/maize, Sudan grass, sugar sorghum, mallow, rye), of heat (fast growing tree species: willow, poplar, oxy tree) or heat & power (Jerusalem artichoke, Cup plant, Miscanthus, Sida, flax, hemp). Plants used as energy crops. The economic importance, botany (short characteristics), location conditions (soil and climate conditions) and selected cultivation methods are reported.		
Assessment methods	Lecture / multi-media presentation Demonstration - presentation of dry plant materials Recognizing of energy plants Project work Preparation of presentation (project)		
Recommended readings	1. Schubert R., Schellnhuber H.J., Buchmann N., Epiney A., Griesshammer R., Kulessa M., Messner D., Rahmstorf S., Schmid J., Future bioenergy and sustainable land use, Earthscan London and Sterling VA, London, 2010 2. El Bassam N., Handbook of Bioenergy Crops (A Complete Reference to Species, Development and Applications), Earthscan Ltd., London & Washington DC, 2010, https://nishat2013.files.wordpress.com/2013/11/handbook-of-bioenergy-crops.pdf 3. El Bassam, N., Energy plant species (Their use and impact on environment and development), James & James Ltd UK, London, 1998 4. praca zbiorowa, Energy from field energy crops – a handbook for energy producers, Jyväskylä Innovation Oy, JYVÄSKYLÄ, Finland, 2009, Handbook_for_energy_producers_www_version.pdf 5. Sathaye, J., O. Lucon, A. Rahman, J. Christensen, F. Denton, J. Fujino, G. Heath, S. Kadner, M. Mirza, H. Rudnick, A. Schlaepfer, A. Shmakin, Renewable Energy in the Context of Sustainable Energy, Cambridge University Press, Cambridge, 2011, http://www.mcc-berlin.net/~creutzig/SRREN_Ch09.pdf		
Knowledge	Student identifies and characterises the most important species of energy plants. Student proposes appropriate for different groups of energy crop plants cultivation technologies.		
Skills	Student can choose the appropriate methods of cultivation technologies and formulate recommendation of cultivation for specific groups of energy plants		
Other social competences	Student is aware of the need for education and self-improvement in the use of new technologies		

Course title	CULTIVATION TECHNOLOGY OF ROOT CROPS AND INDUSTRIAL PLANTS		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / field course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-16	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	65
Objectives of the course	Students acquire detailed knowledge of the most important crop species, the quality requirements for their products and their crop production techniques		
Entry requirements	Basic knowledge in botany, plant physiology and arable farming		
Course contents	Botany (short characteristics), choice of varieties and methods of sowing, fertilization, indirect and direct control of weeds and pests, establishment and management of stocks of the most important crops (industrial crops and root crops). Working with fresh and dried plant material, identification of individual species, knowledge of the seeds, yield structure elements, botanical and plant-based characteristics of important industrial plants and root crops Vegetation-related surveys (population density, development stages of industrial plants and root crops, share of yield estimates) in a practice (agricultural testing station in Lipnik), on the basis of which the management claims and measures for agricultural engineering are estimated Cultivation technology of industrial plants and root crops includes economic importance, site conditions (soil and climatic conditions) and the detailed cultivation methods (with crop production, stock management, harvest) of all industrial plants (oil and fiber-producing plants such as rapeseed, camelina, oil mustard, flax and linseed, hemp) and important root crops (potatoes, sugar beet, feed carrots) and catch crops and product quality. Cultivation of industrial plants and root crops cultivated in Poland and Europe.		
Assessment methods	Lecture / Multi-media Presentations Demonstration - showing fresh and dried plant material Recognizing of individual crop species Assessment of the project / presentation Written examination (test)		
Recommended readings	1. Pete Berry, Sarah Cook, Steve Ellis, Peter Gladders and Susie Roques, ADAS., Oilseed rape guide, AHDB, Kenilworth, Warwickshire, 2018 2. Manmohan Sharma , S. K. Gupta , and A. K. Mondal, Production and Trade of Major World Oil Crops, Springer Science+Business Media, 2012 3. team work, Expert guide: Sugar Beet, Bayer CropScience Ltd., Cambridge, 2011 4. Todd, J. and M. Berti. (eds.), Pathway to Commercialization of Industrial Crops, AAIC, London, 2018, 30th Annual Meeting of the Association for the Advancement of IndustrialCrops (AAIC). Program and Abstracts. September 23-26, 2018, London 5. team work: MultiHemp, Report on the effects of agronomic practices on hemp biomass yield (fibre and seeds) and quality, Università Cattolica del Sacro Cuore, Piacenza, Italy, 2017, FP7 EU – MultiHemp – Multipurpose hemp for industrial bioproducts and biomass		
Knowledge	The student is aware of the importance of industrial plants and root crops in the economy of Europe and Poland, describes the types of industrial plants and root crops grown in Europe. The student knows the cultivation technique of industrial plants and root crops. The student knows the ways of development (trends, directions of future use), processing and correct use of the individual plant species		
Skills	The student is able to enumerate the principles and importance of the production of industrial plants and root crops and can choose the appropriate method and technology of cultivation that will achieve the profitability of production and will not be detrimental to the environment. The student has the ability to correctly classify industrial crops and root crops. Indicates the yield potential of individual plant species.		
Other social competences	The student is aware of the importance and understanding of the agrotechnical aspects of engineering, including its effects on the environment, and the associated decision-making responsibility		

Course title	DECORATING WITH PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Salachna	**E-mail address to the person**	Piotr.Salachna@zut.edu.pl
Course code (if applicable)	WKSiR-2-17	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Students will be able to categorize plants based on growth, morphological, and taxonomic characteristics. Students will be able to interior design with plants. Students will be able to identify, grow, maintain, and use indoors plants.		
Entry requirements	Basic knowledge of ornamental plants		
Course contents	Plants for interior designs. Foliage plants. Flowering plants. Tools and techniques. Designing with pot plants: forms, balance, focus, proportion, rhythm, color and texture, style, containers. Indoor plant culture. Hydroponics indoors. Green walls.		
Assessment methods	Lecture Laboratory project work/grade work test		
Recommended readings	1. Gregor L., Principles of floral design, Floral Designe Edition, Munster, Germany, 2005		
Knowledge	Student has knowledge of the principles and elements of floral art.		
Skills	Student is able to create different floral designs		
Other social competences	The student is aware of the need of self-education and ready to work in team.		

Course title	DIFFERENTIAL EQUATIONS		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Arkadiusz Telesiński	**E-mail address to the person**	Arkadiusz.Telesinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-18	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	50
Objectives of the course	Solving of differential equations of physics, chemistry and engineering, and a study of the characteristics of the solutions		
Entry requirements	Basic knowledge of mathematical analysis and linear algebra		
Course contents	Solving of differential equations First order Differential Equations (separation of variables, linear equations, qualitative techniques - slope fields; existence and uniqueness, Euler's method, wquilibria and the phase line, bifurcations) First Order systems (qualitative methods; analytic methods for special cases, Euler's method) Linear systems (properties and the linearity principle, eigenvalues, eigenvectors, straight line solutions; phase plane, complex eigenvalues, 2nd and higher order Differential Equations Forcing and resonance (forcing, sinusoidal forcing, amplitude and phase of steady state) Nonlinear systems (equilibrium point analysis and linearization, qualitative analysis, Hamiltonian systems) Discrete dynamical systems (discrete logistic function; fixed points and periodic points; bifurcations, chaos)		
Assessment methods	Lectures Workshops Self solving of mathematics tasks Self solving mathematics tasks Test		
Recommended readings	1. Bronson R., Costa G.B., Schaum's Outline of Differential Equations, 2014 2. Hsu S.B., Ordinary Differential Equations with Applications, 2011		
Knowledge	The student has knowledge about differential equations and their use.		
Skills	Student can solve differential equations.		
Other social competences	Student is aware of the importance of differential equations in life sciences		

Course title	ECOLOGY		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Joanna Podlasińska	**E-mail address to the person**	Joanna.Podlasinska@zut.edu.pl
Course code (if applicable)	WKSiR-2-19	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	50
Objectives of the course	Provide a comprehensive theoretical and practical knowledge of ecology and agroecology.		
Entry requirements	Basic knowledge of ecology.		
Course contents	Plant occurance. Releve as a basic element for plant communities description Synthetical and analythical analysis of plant communities Adaptation to the environment. Environmental conditions influencing life (climate, water, temperature, radiation, nutrients). Population ecology. Interactions. Behavioral ecology. Ecosystem processes. Communities. Biomes.		
Assessment methods	Lecture / multi-media presentation Discussion Laboratory exercises Interpretative analysis of the results Project method / report Conversational lecture Performance in lectures and laboratories Assessment of the participation in discusion Assesment of the work during couse Exam		
Recommended readings	1. Mackenzie A., Ball A.S., Virdee S.R., Instant notes in ecology., Bios Scientific Publishers, 1988 2. Moss B., Ecology of Fresh Waters., Blackwell Scientific Publications, Oxford, 1983 3. Odum E.P.,, Basic ecology, W.B. Saunders,, Philadelphia, 1983		
Knowledge	Student has knowledge about relationships occurring between organisms and organisms and the environment.		
Skills	Students understands that processes occurring in environment are observe as changes in biota condition. Studen is able to apply the proper method for observing the relationships occurring between organisms and organisms and the environment.		
Other social competences	Student demonstrates understanding the important role of relationships occurring between organisms and organisms and the environment. Sees the need of self-development and further education.		

Course title	ECOMONITORING AND BIOINDICATION		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / lecture		
Person responsible for the course	Joanna Podlasińska	**E-mail address to the person**	Joanna.Podlasinska@zut.edu.pl
Course code (if applicable)	WKSiR-2-20	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40
Objectives of the course	Developing of knowledge on biomonitors and bioindicators, as well as methods used biomonitoring.		
Entry requirements	Basic biology.		
Course contents	Perfect bioinficators Biomonitoring of sulfur dioxide Biomonitoring of hydrogen fluoride Biomonitoring of O3 Biomonitoring of heavy metals Plant and mushrrom samples preparation for heavy metals analyses. Determination of Hg in mushroom samples. Plants and animals as indicators and biomonitors. Symptoms of air pollution injury. Biomonitoring of major and minor pollutants (photochemical oxidants, sulfur dioxide, SO2 with lower plants, hydrogen fluoride, heavy metals, dust, ethylene). Biomonitoring of water pollutants. Biomonitoring of soil pollutants.		
Assessment methods	Lecture / multi-media presentation Discussion Laboratory exercises Interpretative analysis of the results Project method / report Conversational lecture Performance in lectures and laboratories Assessment of the participation in discusion AAssesment of the laboratory work Report evaluation		
Recommended readings	1. Manning W.J., Feder W. A,, Biomonitoring air pollutants with plants,, Applied Science Publishers LTD,, London, 1980		
Knowledge	Student has knowledge about processes occurring in the environment and about changes in biota condition.		
Skills	Students understands that processes occurring in the environment can be observed as changes in biota condition. Studen is able to apply the proper method for biomonitoring and bioindication experiment.		
Other social competences	Student demonstrates understanding processes occurring in the environment and their influence on biota condition. Sees the need of self-development and further education.		

Course title	ECOTOXICOLOGY		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Arkadiusz Telesiński	**E-mail address to the person**	Arkadiusz.Telesinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-21	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	After finishing the course students should know basic principles of toxicology. Students have ability to describe adsorption, distribution, biotransformation and excretion of xenobiotics and also the influence of toxic agents on live organisms. Furthemore they should know the problems of the influence of the antropogenic pollution and accumulation of xenobiotics in environment. Students should have a knowledge about such pollutants as: nitric compounds, heavy metals, pesticides, fluoride and dioxin. Moreover student should be able to assess toxicity of xenobiotics with using of toxicity tests.		
Entry requirements	Basic knowledge about environmental protection and chemistry		
Course contents	Soil enzymatic activity as indicator of contamination with heavy metals Phytotoxicity tests Parameters of oxidative stress as response of plants to soil contamination Chromatographic metods to determine organic compounds in environmental samples Potentiometric methods to determine fluoride contents in environmental samples Basic principles of toxicology Problems of the industrial pollution effect on livestock and animals health as well as accumulation of the toxins in environment Influence of the intensive use of the fertilizers and pesticides on the toxicity of fed; toxicological analysis, toxicity tests, selected issues in ecotoxicology		
Assessment methods	Lectures Laboratories Pass laboratory conspects Test		
Recommended readings	1. Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B., Principles of ecotoxicology., CRC Press, 2005 2. Hoffman D.J. [eds.], Handbook of ecotoxicology., CRC Press		
Knowledge	Student has a basic knowledge of xenobiotics and their fate in the environment and the negative impact on man and the individual elements of ecosystems.		
Skills	The student can choose the basic measurement techniques for the assessment of ecotoxicity of various pollutants		
Other social competences	The student can work in a team and demonstrate the ability to work in the laboratory division		

Course title	EDIBLE FLOWERS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Kamila Bojko	**E-mail address to the person**	kamila-bojko@zut.edu.pl
Course code (if applicable)	WKSiR-2-22	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40
Objectives of the course	Providing knowledge of edible flower species and methods of their cultivation Providing knowledge of biological value of edible flowers Providing knowledge of processing and storage methods of edible flowers		
Entry requirements	Basic knowledge of horticultural crops		
Course contents	Biologically active compounds of edible flowers. Methods of storage and processing edible flowers Characteristics of the main species of edible flowers Growing methods of edible flowers Methods of storage and processing edible flowers Culinary usage of edible flowers in different cuisines of the world		
Assessment methods	Lecture / multi-media presentation Discussion Completion of the assignments Laboratory exercises Interpretative analysis of the laboratory exercise results Project method / report Conversational lecture Demonstration - Presentation of the collection of edible flower species at the Department of Horticulture WUT Performance in lectures and laboratories Assessment of the participation in the conversational lecture Assessment of the participation in the discussion Written exam Assessment of the homework assignments Assessment of laboratory work skills Report		
Recommended readings	1. Creasy R., The edible flower garden, Periplus Editions (HK) Ltd., Boston, 1999 2. Roberts M., 100 Edible & Healing Flowers, Struik Nature, Cape Town, South Africa, 2014		
Knowledge	Student has knowledge of the main edible flower species, methods of their cultivation, storage and processing Student has knowledge of biological value of edible flowers		
Skills	Student has skills to adjust the specific methods of storage and processing to the particular species of edible flowers		
Other social competences	Student is aware of the importance of increasing the horticultural crop assortment and introducing new technologies supporting the nutritional and pro-health value of food		

Course title	ENVIRONMENTAL ANALYTICAL CHEMISTRY		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / lecture		
Person responsible for the course	Małgorzata Włodarczyk	**E-mail address to the person**	Malgorzata.Wlodarczyk@zut.edu.pl
Course code (if applicable)	WKSiR-2-23	**ECTS points**	7
Semester	winter/summer	**Language of instruction**	english
Hours per week	5	**Hours per semester**	75
Objectives of the course	To familiarize students with the analytical methods used in environmental analysis . Students acquire the skills to work in a analytical lab in terms of quantitative analysis of the chemical compounds. Students acquire the skills to perform chemical and analytical calculations. Students acquire the skills of interpretation and compilation of the chemical analysis.		
Entry requirements	Basic knowledge of general chemistry, mathematics and statistics at the secondary level.		
Course contents	Concentration of solutions, percentage concentration, molar concentration. Changing solution concentrations - calculation. Writing and balancing chemical equations. Writing and balancing oxidation-reduction reactions. Calculations based on chemical equations. Calculation based on acid-base titration, redox titration, gravimetry, complexiметry. Calculation of calibration curve. Calculation used in the environmental analysis based on the UV-VIS, AAS and chromatography methods. Learning principles in the chemical laboratory. Basics of quantitative analysis. Quantitative analysis: volumetric and instrumental methods, learning of pipetting and titration. Determination of absorption curve of chosen environmental pollutants. Determination of selected pollutants (e.g.: heavy metals, chosen biogenic compounds.) in environmental samples by UV-VIS and AAS methods . Electrochemistry. Determination of selected ions by IES. Potentiometry. Conductometric titration. Calculations based on the classical and instrumental quantitative analysis. Lecture I - II. Introduction. The basic concepts of analytical chemistry. The stages of the analytical process. The sample preparation. Measuring methods. Standards. Calibration curve. Lecture III. Elaborate results. Statistical evaluation, errors in the analysis. Lecture IV -V. Quantitative analysis - introduction. Acid-base titration, redox titration, gravimetry, complexiметry, indicators. LECTURE VI - IX. Spectroscopy. Spectroscopic methods in the environmental analysis. Absorbance, Transmittance, Absorption Lows. Spectrophotometry UV-VIS. Atomic Absorption Spectrometry. LECTURE X -XI. Electroanalytical methods in the environmental analysis (potentiometry, conductometry) LECTURE XII -XV. Chromatographic methods in the environmental analysis - introduction. Gas chromatography, Liquid chromatography. Basic concepts and definitions. Equipment - the basic elements.		
Assessment methods	Multimedia lecture. Practical exercises Lecture: grade Workshop : tests, grade Laboratory: projectwork - reports, Laboratory: tests, grade Discussion during the classes		
Recommended readings	1. F. W. Fifield, P. J. Haines., Environmental Analytical Chemistry, Oxford, United Kingdom, 2000 2. Daniel C. Harris, Quantitative Chemical Analysis, 2010 3. , James Carr, Analytical Chemistry and Quantitative Analysis, 2010		
Knowledge	Student has the knowledge about quantitative chemical analysis which is a key part of environmental chemistry, since it provides the data that frame most environmental studies. He knows the basic analytical methods used in the study and monitoring of the environment. He can predict the direction of the chemical compounds change and assess the impact of these changes on the environment.		
Skills	Student knows the good laboratory practice skills in the chemical and analytical laboratory. Independently he performs designation of qualitative analysis (eg. he determines a chemical composition of environment). He can develop and interpret the results of the chemical analysis.		
Other social competences	Students will practice to collaborate and solve problems in group using “problem based learning” methods.		

Course title	ENVIRONMENTAL CHEMISTRY		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Małgorzata Gałczyńska	**E-mail address to the person**	Malgorzata.Galczynska@zut.edu.pl
Course code (if applicable)	WKSiR-2-24	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	The overall goal of this course is to gain an understanding of the fundamental chemical processes that are central to a range of important environmental problems and to utilize this knowledge in making critical evaluations of these problems. C1 An understanding of the chemistry of the stratospheric ozone layer and of the important ozone depletion processes. C2 An understanding of the chemistry of important tropospheric processes, including photochemical smog and acid precipitation. C3 An understanding of the basic physics of the greenhouse effect, the sources and sinks of the family of greenhouse gases, and the implication for climate change. C4 An understanding of the nature, reactivity, and environmental fates of toxic organic chemicals. C5 An understanding of the chemistry of natural waters and of their pollution and purification.		
Entry requirements	Basic knowledge of general, inorganic and organic chemistry		
Course contents	Environmental sampling and statistics Determination of water content in soil and soil pH Short field trip. Determination of dissolved oxygen in water and pH water Short field trip and water samples collection. Determination of nitrogen and phosphorus compounds in water Determination of gas emissions The chemistry of processes in the atmosphere (atmospheric gases, tropospheric and stratospheric chemistry, greenhouse gases). The chemistry of processes in the lithosphere (chemical composition, chemical weathering of rock – oxidation, carbonation, hydrolysis, hydration). The chemistry of processes in the hydrosphere (types and composition of natural waters, gases, organic matter and metals in water). Green chemistry		
Assessment methods	Multimedia presentations Discussion Laboratory exercises Interpretative analysis of the laboratory exercise results Assessment of the participation in the discussion Written test Essay - Climate change mitigation Reports of chemical analysis		
Recommended readings	1. Gary W vanLoon and Stephen J Duffy, Environmental Chemistry, A global perspective (Third Edition)., Oxford University Press, UK, 2010, Third Edition 2. Jorge G. Ibanez, Margarita Hernandez-Esparza, Carmen Doria-Serrano, Arturo Fregoso-Infante, Mono Mohan Singh, Environmental Chemistry Fundamentals, Springer Science-Business Media, LLC., 2007 3. Peter O'Neill. 1998. Environmental Chemistry, 3rd Edition. CRC Press., Environmental Chemistry, CRC Press., 1998, 3rd Edition		
Knowledge	Student gains theoretical and practical knowledge related to the circulation of elements in nature and their migration in the soil-water-air system		
Skills	Student gains skills self-assessment of chemical composition in different elements of environmental. Moreover, he/she can do chemical analysis of soil, water, and air in environmental laboratories.		
Other social competences	Student demonstrates understanding of phenomena occurring in the environmental. Student sees the need of self-development and further education. Furthermore, every student organizes and leads researches in a team. Students are responsible for ensured equipment.		

Course title	ENVIRONMENTAL POLLUTION		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / lecture		
Person responsible for the course	Joanna Podlasińska	**E-mail address to the person**	Joanna.Podlasinska@zut.edu.pl
Course code (if applicable)	WKSiR-2-25	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40
Objectives of the course	Provide a comprehensive theoretical and practical knowledge of environmental pollution and the latest information in this field.		
Entry requirements	Basic knowledge of environment protection.		
Course contents	The impact of major and minor pollutants on the environment Samples preparation and investigation for water and soil pollution evaluation. Samples preparation and investigation for water and soil pollution evaluation. Pollution and pollutants. The significance of pathways. Changes in environment: environmental concentrations, physical effects, chemical changes in the air, changes in rivers, lakes and estuaries, in the sea and on land. Persistent bioaccumulative and toxic. Pollution at home. Pollution as an international problem. Monitoring in Poland and other countries.		
Assessment methods	Lecture / multi-media presentation Discussion Laboratory exercises Interpretative analysis of the results Project method / report Conversational lecture Performance in lectures and laboratories Assessment of the participation in discusion Continuous assessment of the laboratory work Report evaluation		
Recommended readings	1. Hill M. K., Understanding Environmental Pollution: A Primer., Cambridge University Press,, 2004 2. Guderian R.,, Air pollution,, Springer-Verlag, Berlin, Heidelberg, New York, 1977 3. Holgate M.W, A perspective of environmental pollution, Cambridge University Press,, Cambridge, 1980		
Knowledge	Student gains theoretical and practical knowledge about processes occurring in the environment influencing it's condition as well as knows basic pollutants and processes of their changes in the environment.		
Skills	Students understands that processes occurring in environment are observe as changes in biota condition as well as at the environment. Studen is able to apply the proper method for observing the basic pollutants migration and processes of their changes in the environment.		
Other social competences	Student demonstrates understanding the importance of pollutants migration and processes of their changes in the environment. Sees the need of self-development and further education.		

Course title	EVOLUTION ON MOLECULAR LEVEL		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Masojć	**E-mail address to the person**	Piotr.Masojc@zut.edu.pl
Course code (if applicable)	WKSiR-2-26	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Understanding of evolution theory on the molecular level		
Entry requirements	molecular biology genetics		
Course contents	Construction of phylogenetic trees on the basis of marker and DNA sequence data Theories on pre-biotic evolution Concept of molecular clock Molecular mechanisms underlying changes at the genome level Mechanisms underlying evolution at the gene level Examples of protein evolution Exons and introns in evolution Evolution written in the DNA sequence Mitochondrial DNA to track human evolution Chromosome Y DNA to track human evolution		
Assessment methods	laboratory lecture practical exam written exam		
Recommended readings	1. D.J. Futuyma, Evolution, Sinauer Associates Inc., MA, USA, 2005 2. T. A. Brown, Genomes, Bios Scientific Publishers Ltd., 1999		
Knowledge	Students will know what is a molecular basis of evolutionary change in living organisms		
Skills	Students explain molecular mechanisms leading to evolutionary changes		
Other social competences	Student is aware of a complexity of the molecular mechanisms leading to evolutionary changes		

Course title	FLORAL DESIGN		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Salachna	**E-mail address to the person**	Piotr.Salachna@zut.edu.pl
Course code (if applicable)	WKSiR-2-27	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Students will be able to define and describe the principles and elements of floral art, create different floral designs and understand their relationship with interior decor. Hands-on laboratory experiences will allow students to practice the floral arrangements.		
Entry requirements	Basic knowledge of ornamental plants		
Course contents	Techniques. Hand tied flower bouquet. Home decorations and table arrangements. Floral wedding designs. Floral designs for funerals. Ikebana. Principles of artistic floral design. Composition. Color Theory. Design Shapes. Tools and accessories. Arrangement categories. Arrangement of lines. Proportions. Structural designing.		
Assessment methods	Lecture Laboratory project work/grade work test		
Recommended readings	1. Gregor L., Principles of floral design, Floral Designe Edition, Munster, Germany, 2005		
Knowledge	Student has knowledge of the principles and elements of floral art.		
Skills	Student is able to create different floral designs		
Other social competences	The student is aware of the need of self-education and ready to work in team.		

Course title	FRUIT-GROWING		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Chełpiński	**E-mail address to the person**	Piotr.Chelpinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-28	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	Getting to know the species and cultivars of fruit plants.Familiarization with the requirements and principles of cultivation of various species of fruit plants Getting Acquainted with modern technology fruit crops. Acquainted with modern models orchards and beries plantation and the functioning of modern fruit farms		
Entry requirements	Knowledge of morphology, anatomy and systematics of plants, knowledge of the regulation of life processes of plants, knowledge of pathogens on plants, basic physico-chemical properties of soils and fertilizers		
Course contents	Pomology. Pomology Models orchards and beries plantation Location orchards and plantations. Choosing a position, production rules. The assortment of species and functional characteristics of fruit (shape, size, color, destiny fruit). Principles of operation of the farm orchard T-A-1 Basics of regulating the growth and flowering and the protection of trees and shrubs.10 25 T-W-1 Requirements and cultivation of various species of trees and shrubs - the soil, mineral nutrition, irrigation. Location orchards and plantations. Choosing a position. Rules of production 25 T-A-1 Tree protection against external influences - hail, rain, birds.8 T-A-2 Pomology 7 T-W-1 Location orchards and plantations. Choosing a position, production rules.		
Assessment methods	Methods of feeding (lecture informative, conversational) Activating methods (didactic discussion related to the lecture) Methods exposing (figures, tables, photographs, collections of plants) practical methods (display) the Methods for evaluating (F - forming) FS-1 test F S-2 recognition of plants exam (summary form)		
Recommended readings	1. . T. Wallace & R.G. W. Bush., Modern Commercial Fruit Growing., 2009 2. . Adams C. K., Principles of Horticulture., Butterworth-Heinemann, 2008		
Knowledge	student has knowledge of species and cultivars of fruit and their requirements Student has knowledge about cultivation and production organization in fruit-growing.He has knowledge of species and varieties of fruit and their requirements Student knows the modern technologies of cultivation of trees and bushes		
Skills	The ability to identify species and varieties of fruit plants. The ability of cultivation of fruit trees and bushes The ability diagnostics hazards in the production process student has the basic ability to manage production orchard		
Other social competences	student is versed in current trends and production technologies jn fruit-growing student is aware of the production of high-quality fruit. student is able to organize work in a team		

Course title	FUNDAMENTALS OF SOIL SCIENCE WITH ELEMENTS OF SOIL CARTOGRAPHY		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / field course / lecture		
Person responsible for the course	Marek Podlasiński	**E-mail address to the person**	Marek.Podlasinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-29	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	50
Objectives of the course	Provide a comprehensive theoretical and practical knowledge of soil science and soil cartography and the latest information in this field.		
Entry requirements	Basic knowledge of environment protection.		
Course contents	Basic concepts of the soil chemical environment and the inherent chemical characteristics and their reactions/interactions within the soil environment. Concepts include cation exchange capacity, oxidation/reduction and pH as well as implications for management of soil chemistry with laboratory and field techniques, fate and transport of chemicals in soils, and issues associated with salt affected soils. The availability of nutrients under different scenarios as well as managing the availability of those nutrients in considering acidifying and liming soils, nutrient sources and fertilizers. Sampling techniques with interpretation of the results. Methods, techniques and technologies used in soil science and soil cartography. Practising description of soil genesis, classification and morphology. Soil morphology. Soil forming factors. Soil genesis, soil classification. Soil mapping. Soil geomorphology. An overview of basic physical properties of soil with an emphasis on how these properties influence soil-water relationships, temperature, aeration and mechanical characteristics. Various aspects of soil and water management that affect our ability to maintain a healthy environment while still relying on the soil for production of food and fiber, water quality, and overall management of land resources. Erosion and sedimentation, soil quality, water quality, policy and regulations, and a discussion of soil resources and management associated with urban, forest, and agricultural land uses.		
Assessment methods	Lecture / multi-media presentation Discussion Laboratory exercises Interpretative analysis of the results Project method / report Conversational lecture Performance in lectures and laboratories Assessment of the participation in discusion Continuous assessment of the laboratory work Report evaluation		
Recommended readings	1. Buckman H.C.; Brady N.S., The nature and properties of sioils, The macmillan Company, London, 1960 2. Wild A., Soils and the environment: an introduction, Cambridge university press, Cambridge, 1995 3. Ross S., Soil processes. A systematic Approach, Routledge, New York, 1953		
Knowledge	Student gains the knowledge of the soil genesis, classification and morphology, physics, chemistry, fertility, biology and land use.		
Skills	Student should be able to describe the changes in soil; methods, techniques and technologies used in soil science and soil cartography. Provide some laboratory and field works.		
Other social competences	Student demonstrates understanding the importance of soils and processes of their creation as well as changes in the environment. Sees the need of self-development and further education.		

Course title	GENETICALLY MODIFIED CROPS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Miłosz Smolik	**E-mail address to the person**	Milosz.Smolik@zut.edu.pl
Course code (if applicable)	WKSiR-2-30	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	1	**Hours per semester**	23
Objectives of the course	To ensure that students are informed of contemporary aspects of GMOs in agriculture/horticulture/biotechnology. Students are able investigate the presence of main genes construct (inserts) in selected plant material and to evaluate their influence on environment including aspects of the safety issues.		
Entry requirements	Strong background in plant genetics and basis in plant molecular biology.		
Course contents	Samples used during the course. Extraction and purification of DNA. Qualitative detection of MON810 maize. Agarose gel electrophoresis. Qualitative detection of Bt-176 maize. Agarose gel electrophoresis. Qualitative detection of Roundup Ready® soybean by PCR. Agarose gel electrophoresis. Results presentation. Introduction to genetically modified crops. Methods used in plant transgenesis. Genes and strategies used in plant transformation. Coexistence of genetically modified crops with conventional and organic agriculture. The EU's legislation and policy on GMOs.		
Assessment methods	Multimedia lecture Laboratory Report Discussion, laboratory skills Test		
Recommended readings	1. Romeis, J., M. Meissle and F. Bigler, Transgenic crops expressing Bacillus thuringiensis toxins and biological control, Nature Biotechnology, 2006, 24: 63-71		
Knowledge	Student will know what kind of genes and methods have been used in genetically modifications of different crops		
Skills	Student will know how to provide test for GMO identification by PCR		
Other social competences	Student will know how important is work in the group. The student knows the advantages and risks by the cultivation of GMOs		

Course title	GEOGRAPHIC INFORMATION SYSTEMS FOR RENEWABLE ENERGY ANALYSIS		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Podlasiński	**E-mail address to the person**	Marek.Podlasinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-31	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	Developing of basis theoretical knowledge on geospatial subjects. Gaining a practical understanding of GIS concepts, techniques and real world applications, understanding the technical language of GIS, gaining practical experience using basic GIS tools		
Entry requirements	Basic informatics knowledge		
Course contents	Methods of data implementing and integrating in GIS: scanning, digitizing, georeferencing Frequently used GIS analysis – reclassification, buffering, logic operations, map comparison, time series analysis, landscape analysis, thematic mapping, etc. GIS analysis and visualization methods in environmental sciences GPS data and their use in GIS Data sources for geospatial sciences Cartographic base in GIS – projections, scale, coordinate systems, map types, visualization of geospatial data Data models in GIS – vector and raster GIS analysis and visualization methods in environmental sciences Legal and copyright aspects of GIS practices		
Assessment methods	lectures, mini projects, practical exercises project work/grade work		
Recommended readings	1. Longley, P. M. Goodchild, D. Maguire and D. Rhind., Geographic Information Systems and Science, John Wiley and Sons., 2007 2. Eastman J.R, Idrisi TAiga. User's Guide, Clarck Labs, 2011		
Knowledge	Student has the knowledge about theoretical aspects of GIS, data models, basic analytic methods and procedures, data sources, geographic and cartographic background.		
Skills	Student has practical abilities of operations on different data types, basic geographic analysis, import/export procedures and operations used commonly in environmental policies processes		
Other social competences	Student demonstrates understanding of importance of spatial analysis for ensuring environmental policies and development of natural sciences		

Course title	GEOGRAPHIC INFORMATION SYSTEMS IN ENVIRONMENT PROTECTION AND SPATIAL PLANNING		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Podlasiński	**E-mail address to the person**	Marek.Podlasinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-32	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45

Objectives of the course	Developing of basis theoretical knowledge on geospatial subjects. Gaining a practical understanding of GIS concepts, techniques and real world applications, understanding the technical language of GIS, gaining practical experience using basic GIS tools
Entry requirements	Basic informatics knowledge
Course contents	Methods of data implementing and integrating in GIS: scanning, digitizing, georeferencing Frequently used GIS analysis – reclassification, buffering, logic operations, map comparison, time series analysis, landscape analysis, thematic mapping, etc. GIS analysis and visualization methods in environmental sciences GPS data and their use in GIS Data sources for geospatial sciences Cartographic base in GIS – projections, scale, coordinate systems, map types, visualization of geospatial data Data models in GIS – vector and raster GIS analysis and visualization methods in environmental sciences Legal and copyright aspects of GIS practices
Assessment methods	lectures, mini projects, practical exercises project work/grade work
Recommended readings	1. Longley, P. M. Goodchild, D. Maguire and D. Rhind., Geographic Information Systems and Science, John Wiley and Sons., 2007 2. Eastman J.R, Idrisi TAiga. User's Guide, Clarck Labs, 2011
Knowledge	Student has the knowledge about theoretical aspects of GIS, data models, basic analytic methods and procedures, data sources, geographic and cartographic background.
Skills	Student has practical abilities of operations on different data types, basic geographic analysis, import/export procedures and operations used commonly in environmental policies processes
Other social competences	Student demonstrates understanding of importance of spatial analysis for ensuring environmental policies and development of natural sciences

Course title	GROWING OF ALTERNATIVE PLANT SPECIES		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-33	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Students acquire detailed knowledge of the most important alternative plant species, the quality requirements for their products and their production techniques, with a focus on arable crops in temperate climates		
Entry requirements	Basic knowledge of botany, plant physiology and plant cultivation		
Course contents	Botany (short characteristics), choice of varieties and methods of sowing, fertilization, indirect and direct control of weeds and pests, establishment and management of stocks of the most important crops (industrial crops and root crops). Cultivation of alternative plants is intended for the cultivation technologies of plant species used for food production and as raw materials for the cosmetics industry, e.g. Sugar Millet, Buckwheat, Quinoa, Amaranthus, Oillein, Borage, Russian Dandelion, Camelina, Miracle Tree) Also Dyeing Plants (Madder, Resede, Waid). It is reported on the economic importance, botany (short characteristics), site conditions (soil and climatic conditions) and selected cultivation methods		
Assessment methods	Lecture / multi-media presentations Identification (detection) of individual plant species Preparation of presentations / projects Evaluation of presentations / Projects		
Recommended readings	1. Thomas McKeon, Douglas Hayes, David Hildebrand, Randall Weselake (eds.), Industrial Oil Crops, Academic Press and AOCS Press, 2016, 1. edition, eBook ISBN: 9780128053850. pp. 474 2. A B Obilana, Sorghum - breeding and agronomy, ICRISAT, Hyderabad, Andra Pradesh, India, 2004 3. Sharma, M., Gupta, S. K., & Mondal, A. K., Sharma, M., Gupta, S. KProduction and Trade of Major World Oil Crops. Technological Innovations in Major World Oil Crops,, Springer New York, New York, 2011, Volume 1, 1–15., doi:10.1007/978-1-4614-0356-2_1 4. Kauffman, C.S., and L.E. Weber, Grain amaranth, Timber Press, Portland, OR, 1990, p. 127-139., In: J. Janick and J.E. Simon (eds.), Advances in new crops. 5. Pavek, P.L.S, Plant Guide for buckwheat (Fagopyrum esculentum)., USDA-Natural Resources Conservation Service,, Pullman Plant Materials Center. Pullman, WA., 2016 6. Team work, Energy from field energy crops – a handbook for energy producers, Jyväskylä Innovation Oy, JYVÄSKYLÄ, Finland, 2009, Handbook_for_energy_producers_www_version.pdf		
Knowledge	The student is aware of the importance of alternative plant species in the economy. The student knows the cultivation technique of alternative plant species		
Skills	The student is able to enumerate the principles and importance of the production of alternative crops and can choose the appropriate method and technology of cultivation that guarantees the profitability of the production		
Other social competences	The student is aware of the importance and understanding of the agrotechnical aspects of engineering, including its effects on the environment, and the associated decision-making responsibility		

Course title	INTEGRATED WEED CONTROL METHODS		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-34	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	recognition of the role of weeds and their importance in agrocenosis and selection of appropriate methods to reduce weed infestation		
Entry requirements	Botany, plant nutrition, plant cultivation and plant physiology, soil science		
Course contents	The role of herbicides in controlling weed infestation of crops. Herbicide application technology - threats to the user, the environment and weed control resulting from improper application Weeds and their importance in agrocenoses in terms of biodiversity and combating them. Influence of habitat and agrotechnical factors on the condition and degree of weed infestation of agricultural plants. Prevention of weed infestation and review of modern methods of weed control		
Assessment methods	Lectures multi media presentations Written work / project work (presentation) Evaluation of presentation / project		
Recommended readings	1. Team work Susan Jellis (ed.), Encyclopaedia of arable weeds, Folia Partners Ltd, Warwickshire, 2018, ahdb.org.uk/knowledge-library/encyclopaedia-of-arable-weeds 2. Clarence J. Swanton, Kris J. Mahoney, Kevin Chandler, and Robert H. Gulden, Integrated Weed Management: Knowledge-Based Weed Management Systems, Weed Science Society of America, 2008, Source: Weed Science, 56(1):168-172. 3. Timothy J. Krupnik, Kamrun Naher, Shafiq Islam, Md. Arshadul Hoque, Apurba Roy, Virender Kumar, Israil Hossain, Khaled Hossain, Sumona Shahrin, Mahesh Kumar Gathala, Anil Shrestha and Sheikh Md. Nazim Uddin, INTEGRATED WEED MANAGEMENT: Experiential learning modules – Book 2., CIMMYT- Bangladesh, Gulshan, Dhaka, 2016, Cereal Systems Initiative for South Asia 4. SS Rana and MC Rana, Principles and Practices of Weed Management, Department of Agronomy, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya,, Palampur, India, 2016		
Knowledge	Student identifies and characterises the most important weed species on fields. Student proposes appropriate for different groups of weeds methods of integrated control		
Skills	Student can choose the appropriate methods of weed control and formulate recommend of integrated method for specific groups of weeds		
Other social competences	Student is aware of the need for education and self-improvement in the use of new technologies in weed control		

Course title	LANDSCAPE DESIGN		
Level of course	second cycle		
Teaching method	project course / lecture		
Person responsible for the course	Magdalena Rzeszotarska-Pałka	**E-mail address to the person**	Magdalena.Rzeszotarska-Palka@zut.edu.pl
Course code (if applicable)	WKSiR-2-35	**ECTS points**	6
Semester	summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60

Objectives of the course	Acquires extended knowledge in the field of shaping various landscape architecture objects, both in urban and open landscapes. Acquires knowledge of basic methods, techniques, tools and materials used in designs of complex landscape architecture objects. Acquires the skills required to develop a comprehensive design for a complex landscape architecture object, taking into account detailed structural and material solutions, as well as the appropriate selection of vegetation. Acquires the knowledge and skills in the field of using plants in landscape architecture designs.
Entry requirements	Knowledge of the principles of landscape design
Course contents	Main stages and methodology of the land development project Development of land inventory, landscape analysis and valorisation Development of preliminary design guidelines Mid-semester review in the inventory phase and preliminary design guidelines Development of a detailed land development project Mid-semester review in the detailed design phase Selection of trees and shrubs in terms of habitat, composition and their applicability for the design task Selection of decorative plants in terms of their composition and habitat for the design task Selection of appropriate material and construction solutions for the respective elements of the design task Preparation to present the project on boards and in the form of a multimedia presentation Stages and methodology of project development The appropriate selection of vegetation for the deisgn task The appropriate selection of detailed structural and material solutions for the design task
Assessment methods	Information lecture illustrated with the use of multimedia techniques Activating methods: the method of cases, situational method Project (design) method, case study Continuous assessment Intermediate presentations: mid-semster review Final evaluation of individual project
Recommended readings	1. Vidella A.S., The sourcebook of contemporary landscape design, Collins Design, New York, 2008 2. Waterman T., The Fundamentals of Landscape Architecture, Bloomsbury Publishinh PLC, Londyn, 2015 3. Landscape Architecture, magazine, Wrocław 4. Braham R., First lessons in dendrology, Kendall Hunt Publishing, 2012
Knowledge	Acquires extended knowledge in the field of shaping various landscape architecture objects, both in urban and open landscapes. Acquires knowledge of basic methods, techniques, tools and materials used in designs of complex landscape architecture objects.
Skills	Acquires the skills required to develop a comprehensive design for a complex landscape architecture object, taking into account detailed structural and material solutions, as well as the appropriate selection of vegetation.
Other social competences	Correctly identifies and solves problems that arise during the development of a design task. Is able to cooperate within the project team. Analyzes the design task in its numerous aspects and formulates the right solutions.

Course title	LIFE CYCLE ASSESMENT		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Małgorzata Gałczyńska	**E-mail address to the person**	Malgorzata.Galczynska@zut.edu.pl
Course code (if applicable)	WKSiR-2-36	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	The goals of the course are: 1) to introduce students to the fundamental concepts related to interaction of industrial and environmental/ecological systems, sustainability challenges facing the current generation, and systems-based approaches required to create sustainable solutions for society, 2) to understanding the concepts and the scientific method as it applies to a systems-based, trans-disciplinary approach to sustainability, 3) to preparation to identify problems in sustainability and formulate appropriate solutions based on scientific research, applied science, social and economic issues The workshop will focus on use basic analyst's competence in Life Cycle Assessment (LCA).		
Entry requirements	Basic knowledge of general chemistry Basic knowledge of environmental chemistry		
Course contents	LCA software tools and databases. Critical review of an LCA study. Application areas of LCA and limitations. Presentation - LCA in relation to other environmental systems analysis tools for the selected example. LCA in relation to other environmental systems analysis tools. Methodology for the different phases of an LCA (goal definition and scoping, inventory analysis, impact assessment and interpretation). Methodology for simplified LCA. Multiple choice test		
Assessment methods	Multimedia presentations Discuss possible applications and limitiations of LCA Computer labs Reports of LCA analysis Presentation - LCA in relation to other environmental systems analysis tools for the selected example. Assessment of the homework assignments Multiple choice test		
Recommended readings	1. Curran, M. A., Life Cycle Assessment Student Handbook, 2015		
Knowledge	Student gains theoretical and practical knowledge related to LCA in relation to other environmental systems analysis tools and related to the different phases of an LCA		
Skills	Student gains skills self-assessment of LCA method and describes LCA in relation to other environmental systems analysis tools for the selected example.		
Other social competences	Student demonstrates understanding of LCA method. Student sees the need of self-development and further education. Furthermore, every student organizes and leads researches in a team.		

Course title	LIQUID BIOFUELS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Małgorzata Hawrot-Paw	**E-mail address to the person**	Malgorzata.Hawrot-Paw@zut.edu.pl
Course code (if applicable)	WKSiR-2-37	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Knowledge about liquid biofuels, methods and processes of their production and application.		
Entry requirements	Fundamentals of chemical, biochemical and microbiological processes.		
Course contents	Biofuels laboratory regulations and safety regulations. Production of biodiesel. Oil preparation - seed preparation and extrusion. Process of transesterification, separation and purification of esters. Bio biodiesel quality indicators. Production of bioethanol. Characterization of the raw materials to ethanol fermentation and pre-treatment. Effectiveness of the fermentation process. Distillation / rectification process. Purification of bioethanol. Evaluation of bioethanol quality parameters. Evaluation of the basic parameters of the engine powered by bioethanol. Microalgae culture for liquid biofuels. Definition and types of biofuels. Methods of converting biomass into biofuels. Generationion of biofuels. Technologies for the production of liquid biofuels. Biomass pyrolysis process. Synthetic biofuels (BtL). Biohydrogen. Structure of biofuels use in Poland and in the world. Legal regulations on biofuels. Ecological and economic aspects of biofuel production. Comparative analysis for biofuels and conventional fuels.		
Assessment methods	Multimedia lecture. Demonstration. Laboratory exercises. Assessment of the participation in the lecture. Assessment of laboratory work skills. Evaluation oral / written.		
Recommended readings	1. Robert C. Brown, Thermochemical Processing of Biomass: conversion into fuels, chemicals and power, J. Willy & Sons Ltd., London, 2011 2. Ashok Pandey, Christian Larroche, Steven C. Ricke, Claude-Gilles Dussap, Edgard Gnansounou, Biofuels. Alternative Feedstocks and Conversion Processes, Elsevier Inc, 2011		
Knowledge	Knowledge of the production of liquid biofuels and their use for energy production.		
Skills	Ability to produce liquid biofuels according to available technology and transform it into energy in a suitable installation.		
Other social competences	Awareness of your knowledge and skills and the importance of bioenergy.		

Course title	MATHEMATICAL MODELING		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Arkadiusz Telesiński	**E-mail address to the person**	Arkadiusz.Telesinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-38	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40
Objectives of the course	The aim of the course is to provide methods and tools for modeling and analysis of dynamic models described by ordinary differential equations and partial.		
Entry requirements	Basic knowledge of linear algebra, mathematical analysis and theory of probability		
Course contents	Introduction - purpose and scope of modeling, basic definitions. Stages of modeling. Formal description, assumption, model, scale, algorithm, simulation. Model verification Local and global formulation. Scale effect. Deterministic and random models. Static and dynamic models. Analytical and numerical methods of solving. Modeling with differential equations. Optimization methods in modeling. Sensitivity analysis. Reminder knowledge of differential and integral calculus. The concept of the model. Linear and nonlinear models. Static and dynamic models. Models of deterministic and non-deterministic. Models of continuous and discrete. Basic operators. Transform of Laplace, Fourier and Z. Modeling interference. The concept of stochastic processes. Smoothing, filtering and prediction. Ordinary differential equations. Uniqueness of solutions. Initial and boundary conditions. Linear equations. Bringing higher-order equations to a system of first order equations. Matrix derivatives. Compartmental models. Models with fixed parameters. The models of the first, second, third and fourth order. Examples of models of real systems. Properties of compartmental models. Tasks reverse. Traceability parametric models. Regularization. Problems properly defined. Sensitivity and conditioning tasks. The models in the form of state equations. The structure of the model. Partial differential equations. General solution. Initial and boundary conditions. Uniqueness of the solution. The most important types of partial differential equations of second order. General partial differential equation of second order. Classification of linear equations of second order. Basic methods of solving second-order equations: the method of characteristics, method of separated variables, examples. Basic numerical methods for solving linear partial differential equations: finite difference method, Galerkin method, finite element method. The use of Fourier transform for solving equations with boundary conditions. Application of the Laplace transform to solve equations with initial conditions.		
Assessment methods	Lectures Workshops Self solving mathematics tasks Evaluation of self solving mathematics tasks Test		
Recommended readings	1. R. Illner et al., Mathematical Modelling: A Case Studies Approach, AMS, 2005 2. E. Bender, Introduction to Mathematical Modelling, Dover, 2000 3. J. Kapur, Maximum-entropy Models in Science and Engineering, Wiley, 1989		
Knowledge	Student has basic knowledge of mathematics		
Skills	Student can solve mathematical modeling tasks		
Other social competences	Student is aware of the importance of mathematical modeling in life sciences		

Course title	MATHS		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Arkadiusz Telesiński	**E-mail address to the person**	Arkadiusz.Telesinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-39	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	The aim of the course is to acquaint the student with the basic methods of linear algebra and mathematical analysis appearing in the sciences of life. After the course the student should demonstrate: knowledge of basic operations on matrices, the ability to solve systems of equations for calculating the limits of sequences and functions, examination of a function and the calculation of basic integrals		
Entry requirements	Basic mathematical knowledge		
Course contents	Linear equations. Solving linear equations (Gauss-Jordan algorithm) Matrices. Equality of matrices. Addition of matrices. Scalar multiple of a matrix. Matrix product. Linear transformations. The identity matrix. Non–singular matrix. Symmetric and skew–symmetric matrix Determinants. Minors. Cramer’s rule Complex numbers. Geometric representation of complex numbers. Complex conjugate. Modulus of a complex number. Ratio formulae. Argument of a complex number. De Moivre’s theorem Function limits and continuity. Operations on limits. Rational functions. Monotone functions Derivatives of functions of one real variable. L'Hopital’s rule. Function extremes. Study of function Integrals. Indefinite integrals. Riemann's integrals Complex numbers (basic algebraic properties, geometric interpretation of complex numbers) Elements of linear algebra (addition, multiplication, and matrix inversion, solving systems of linear equations) The definition of numerical sequence of numbers, basic operations on strings, over the border, series of numbers Continuity and derivative functions, properties and its use of derivative Extremes function, the study of a function Indefinite and closed integrals		
Assessment methods	Lectures Workshops Self solving mathematics tasks Evaluation of self solving mathematics tasks Test		
Recommended readings	1. Williams G., Linear algebra with applications, 2014 2. Malik S.C., Arora S., Mathematical analysis, 2009		
Knowledge	Student has knowledge about basics of linear algebra and analysis of one real variable functions		
Skills	Student can solve mathematics tasks		
Other social competences	Student is aware of the importance of mathematics in life sciences		

Course title	MEDICINAL AND AROMATIC PLANTS		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Kamila Bojko	**E-mail address to the person**	kamila-bojko@zut.edu.pl
Course code (if applicable)	WKSiR-2-40	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	Providing knowledge of types of herbal materials and their nomenclature Providing knowledge of the major species of medicinal and aromatic herbs - their cultivation methods and properties		
Entry requirements	Basic knowledge of agriculture/horticulture		
Course contents	Detailed characterisation of the main medicinal and aromatic plant species: Arnica montana L., Ocimum basilicum L., Sambucus nigra L., Artemisia dracunculus L., Satureja hortensis L., Hypericum perforatum L., Echinacea purpurea (L.) Moench. Detailed characterisation of the main medicinal and aromatic plant species: Valeriana officinalis L., Lavandula angustifolia Mill., Origanum vulgare L., Levisticum officinale W.D.J. Koch, Origanum majorana L., Melissa officinalis L. Detailed characterisation of the main medicinal and aromatic plant species: Mentha x piperita L., Calendula officinalis L., Digitalis lanata Ehrh., Silybum marianum (L.) Gaertn., Capsicum annuum L., Atropa belladonna L. Detailed characterisation of the main medicinal and aromatic plant species: Urtica dioica L., Althaea officinalis L., Rosa canina L., Chamomilla recutita (L.) Rauschert., Salvia officinalis L. Detailed characterisation of the main medicinal and aromatic plant species: Thymus vulgaris L., Tanacetum parthenium (L.) Sch. Bip., Hyssopus officinalis L., Taraxacum officinale Web., Oenothera biennis L. The history and importance of herbal plant cultivation Types of herbal materials and their nomenclature Biologically active compounds of medicinal and aromatic plants Principles of herbal plant cultivation methods General principles of collecting herbal plants from their native habitats		
Assessment methods	Lecture / multi-media presentation Project method Demonstration - Presentation of raw plant materials (fresh or dried) Performance in lectures and workshops Assessment of homework assignments Assessment of project work Written exam		
Recommended readings	1. Brill S., Dean E., Identifying and harvesting. Edible and medicinal plants, Happer, New York, 1994 2. Peter K.V., Handbook of herbs and spices. Vol. 1 & 2, CRS Press, Cambridge, England, 2001		
Knowledge	Student has basic knowledge of herbalism - types of herbal materials, their nomenclature and biological activity Student has knowledge of the major species of medicinal and aromatic herbs - their cultivation methods and properties		
Skills	Student has skills to recognize the main medicinal and aromatic plants and describe their properties		
Other social competences	Student is aware of the importance of herbs in medicine as well as in the human diet		

Course title	MICROBIOLOGICAL TRANSFORMATION OF BIOMASS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Małgorzata Hawrot-Paw	**E-mail address to the person**	Malgorzata.Hawrot-Paw@zut.edu.pl
Course code (if applicable)	WKSiR-2-41	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Knowledge of the basics of microbiology and microbial processes used for obtaining energy from the biomass.		
Entry requirements	Basic knowledge of biochemistry and physics.		
Course contents	Laboratory regulations and applicable safety regulations. Basic techniques for working with microorganisms. Methods of qualitative-quantitative assessment and microbial activity. Isolation microorganisms active in biomass transformation processes. Morphological, physiological and biochemical characterization of strains. Nutritional requirements of microorganisms. Enzymatic activity and biomass conversion. Biomass - types, properties, energetic application. Introduction to microbiology. Basic groups of microorganisms. Metabolism. Technical basics of microorganism culture (bioreactors). Enzymes in microbiological processes. Methods of biomass conversion and bioconversion (methane fermentation, ethanol fermentation, photo fermentation, dark fermentation, composting - microbiological and biochemical bases).		
Assessment methods	Multimedia lecture. Demonstration. Laboratory exercises. Assessment of laboratory work skills. Evaluation oral / written.		
Recommended readings	1. Jacquelyn G. Black, Microbiology, John Wiley & Sons, Hoboken, NJ, 2013 2. Joan L. Slonczewski, John W. Foster, Microbiology: An Evolving Science, W.W. Norton, New York ; London, 2011 3. Denny K. S. Ng, Raymond R. Tan, Dominic C. Y. Foo, Process Design Strategies for Biomass Conversion Systems, John Wiley & Sons, Chichester, 2016		
Knowledge	Knowledge about the properties and types of biomass and microbiological processes involved in energy generation.		
Skills	Ability to isolate active strains in biomass conversion and use them in selected transformation processes.		
Other social competences	The student understands the importance of bio-energy.		

Course title	MICROBIOLOGY		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / lecture		
Person responsible for the course	Krystyna Cybulska	**E-mail address to the person**	Krystyna.Cybulska@zut.edu.pl
Course code (if applicable)	WKSiR-2-42	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	The aim of the course is to familiarize students with various environmental microorganisms and their role in terrestrial and aquatic ecosystems. Environmental biotechnology (e.g. biodegradation of contaminants from various matrices of the environment, restoration of degraded soils, production of biologicals, recycling of waste) uses the natural activity of bacteria and fungi. Therefore, the aim of the course is to acquaint students with issues related to the environment, using micro-organisms to eliminate impurities on an industrial scale.		
Entry requirements	Basic biology		
Course contents	Fieldwork: Trip to the plants using biotechnology (e.g. biological sewage treatment plant, composting facility, biogas plant) Topics of Laboratories: Soil bacteria and fungi - microscopic observations and tests on selected enzymatic activities. Sludge from the sewage treatment plants - microscopic observations of bacteria and protozoa, biochemical processes. Lactic acid and alcohol fermentation - study of the processes. Topics of lectures: Microorganisms of the environment (soil and water), the characteristics of taxonomic groups and their spread in nature. Fundamentals of physiology and biochemistry of the bacterial cell. The impact of environmental and anthropogenic factors on the formation of unit of soil microorganisms. Interactions between soil organisms. The role of microorganisms in ecosystems. Environmental biotechnology processes used in biotechnology, fundamentals of Applied Microbiology. The use of microorganisms in environmental protection. Biological sewage treatment plants. Bioremediation of soils on degraded areas. Bacteria and fungi in organic farming. Lactic acid and alcohol fermentation in various industries. Microorganisms as a source of renewable energy.		
Assessment methods	Multimedia presentations Laboratory exercises Discussion Pass laboratory conspects Tests		
Recommended readings	1. Lawrence K. Wang, Volodymyr Ivanov, Joo-Hwa Tay, Environmental Biotechnology - online, Springer Link, Humana Press, http://link.springer.com/book/10.1007%2F978-1-60327-140-0, 2010 2. Slonczewski Joan, Microbiology: an evolving science, W.W. Norton, New York; London, 2011 3. Bitton Gabriel, Wastewater microbiology, Hoboken: Wiley-Blackwell, 2011 4. Moo-Young, Murray - Red., Comprehensive biotechnology 1-6, Elsevier, Amsterdam, 2011		
Knowledge	The student knows the structure of soil microorganisms and can discuss their metabolism, environmental activity		
Skills	Student uses basic microbial concepts and is able to do easy tasks, labor exercises		
Other social competences	The student is able to work in a team and demonstrate the ability to the development of their creative potential		

Course title	MOLECULAR BIOLOGY		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Masojć	**E-mail address to the person**	Piotr.Masojc@zut.edu.pl
Course code (if applicable)	WKSiR-2-43	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Understanding of basic molecular mechanisms underlying organisation and regulation of the transfer of genomic information		
Entry requirements	basic genetics basic biochemistry		
Course contents	methods of DNA and RNA isolation polymerase chain reaction (PCR) electrophoresis of DNA electrophoresis of proteins use of restriction enzymes Southern transfer test Organization of genes and gene networks in genomes of Prokaryota and Eukaryota Molecular mechanisms of replication Molecular mechanisms of transcription Molecular mechanisms of translation Molecular mechanisms of recombination Molecular mechanisms of DNA repair Regulation of gene expression Molecular mechanisms of morphogenesis Molecular mechanisms of sex determination Epigenetic mechanisms Molecular mechanisms of immune system Molecular mechanisms of cancer Basic methods of molecular biology		
Assessment methods	Lecture laboratory test		
Recommended readings	1. L.A. Allison, Fundamental Molecular Biology, Blackwell Publishing Ltd, Oxford, 2007, First Edition		
Knowledge	Understanding of molecular mechanisms of genome functioning		
Skills	Ability to differentiate basic processes ongoing in a living cell		
Other social competences	Teaching and explaining of basic molecular processes ongoing in cells of living organisms		

Course title	MOLECULAR DIAGNOSTICS OF CULTIVATED PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Paweł Milczarski	**E-mail address to the person**	Pawel.Milczarski@zut.edu.pl
Course code (if applicable)	WKSiR-2-44	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Knowledge on the methods of identification plants genotypes on a molecular level.		
Entry requirements	Basic of genetics, molecular biology and plant breednig		
Course contents	Planning of experiments, preparation of the necessary equipment, the development of protocols and design of primers for PCR. Isolation, purification and quantification of plant DNA. Methods of generating DNA markers (ISSR, SSR, AFLP, STS,CAPS). Comparing the conditions of separation and detection methods. Choice of molecular markers method for cultivar identification. Protection of property rights to the varieties using marker techniques Methods of detecting DNA and protein variation by molecular markers in plants. An overview of the most important techniques for generating molecular markers. The possibility of using molecular techniques in the diagnosis of plants. Applications of DNA Fingerprinting in Plant Sciences.		
Assessment methods	lecture laboratory practical exercise written exam		
Recommended readings	1. Weising K., Nybom H., Wolf K., Kahl G, DNA Fingerprinting in Plants: Principles, Methods and Aplications, CRC Press Taylor and Francis Group, Boka Raton, 2005, II		
Knowledge	Student will know the most useful techniques of molecular marker identification		
Skills	Students will know how to conduct experiment for identifcation diagnostic problem.		
Other social competences	Student will know how to work in laboratory group and know work safety regulation.		

Course title	MOLECULAR GENETICS OF PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Piotr Masojć	**E-mail address to the person**	Piotr.Masojc@zut.edu.pl
Course code (if applicable)	WKSiR-2-45	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Knowledge on the using of modern molecular tools in identifying of valuable DNA polymorphisms affecting important traits.		
Entry requirements	Basic of genetics, molecular biology and plant breednig		
Course contents	Design of experiments, required equipment and computer programs. Safety regulation. Isolation, purification and quantification of plant DNA and RNA. Methods of generating DNA markers using PCR technology. Amplification, separation and detection. Molecular markers methods in fingerprinting of cultivar plants Generation of markers useful to construct genetic maps. Principles of construction of genetic maps. Methods of identification and location of the QTL. Associative Mapping - data entry and analysis. Characteristics of functional markers, rules for their preparation and use. Introduction to genetics of plants DNA sequencing technology, NGS platform. Techniques of generating molecular markers. Plant materials necessary for search of molecular markers. Methods of DNA fingerprinting. Construction of phylogenetic trees. Construction of genetic maps, QTL identification. Methods of detecting molecular marker - phenotypic trait association. Development of funkctional marker (FM) Selection using molecular markers. Molecular breeding for a given trait using functional markers		
Assessment methods	lecture laboratory practical exercise written exam		
Recommended readings	1. Weising K., Nybom H., Wolf K., Kahl G, DNA Fingerprinting in Plants: Principles, Methods and Aplications, CRC Press Taylor and Francis Group, Boka Raton, 2005, II		
Knowledge	Student will gain knowledge of DNA analysis for identyfication of genetic variation in plants.		
Skills	Students will know how to apply DNA technology in selection and practical breeding.		
Other social competences	Student will know how to work in laboratory group and know work safety regulation.		

Course title	NATURAL ANTIOXIDANTS IN HORTICULTURAL CROPS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Arkadiusz Telesiński	**E-mail address to the person**	Arkadiusz.Telesinski@zut.edu.pl
Course code (if applicable)	WKSiR-2-46	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	After finishing the course students should have ability to describe reactive oxygen species, their formation and effect on cells. Students should have knowledge about structure and properties of low-molecular antioxidant compounds. Furthermore they should be able to choose horticulture crops, which have high concentration of antioxidants.		
Entry requirements	Basic knowledge about vegetables, fruits and herbs; principles of botany, plant physiology and biochemistry.		
Course contents	Datermination of flavonoids Determination of plyphenols Determination of L-ascorbic acid Determination of antioxidant activity Determination of antioxidant capacity Production of reactive oxygen species in environment and organisms. Effect of reactive oxygen species on organisms, oxidative stress, hipermetabolism, organism ageing. Methods of determination of reactive oxygen species, oxidative stress and antioxidants. Characteristics of low-molecular antioxidants: tocopherols, polyphenols, glutathione, ascorbic acid and others. Fruits, vegetables and herbs containing high concentration of antioxidants and their functions in dietetics and pharmacy.		
Assessment methods	Lectures Laboratories Pass laboratory outlines Tests		
Recommended readings	1. Kaeney J.F.Jr. [eds.]., Oxidative stress and vascular disease, Kluwer Academic Press, 2001 2. Packer L., Ong A.S.H. [eds.]., Biological oxidants and antioxidants: molecular mechanisms and health effects., FSTA Direct, 1998		
Knowledge	Student has knowledge about reactive oxygen species and antioxidants		
Skills	Student can determine antioxidants in plant material		
Other social competences	Student can work in the team		

Course title	NON-AGRICULTURAL SOURCES OF BIOMASS		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / lecture		
Person responsible for the course	Grzegorz Jarnuszewski	**E-mail address to the person**	Grzegorz.Jarnuszewski@zut.edu.pl
Course code (if applicable)	WKSiR-2-47	**ECTS points**	1
Semester	winter/summer	**Language of instruction**	english
Hours per week	0	**Hours per semester**	12
Objectives of the course	Student has knowledge of waste management and the use of post-production and waste biomass Student can recognize and select apply technology of biomass for energy purposes Student is aware of further training and the need constantly expand knowledge on the use post-production and waste biomass.		
Entry requirements	Basic knowledge of waste management methods of their management and disposal with the possibility of energy recovery.		
Course contents	Physico-chemical properties and morphological composition of selected wastes as a criterion of their usefulness for combustion Practical presentation of waste processing technology (ZPOiPPA NewCo). Characterization, division and origin of wood waste, furniture, sewage sludge, food and pulp and paper industry. Methods of using biomass from waste from non-agricultural activities.		
Assessment methods	Lectures/Multimedia presentations Laboratories/demonstration, synopsis elaboration test		
Recommended readings	1. Khanal S.K., Surampalli R.Y., Zhang T.C., Lamsal B.P., Tyagi R.D., Kao C.M., Bioenergy and biofuela from biowastes and biomas, American Society of Civil Engineers, Reston, Virginia, 2010 2. Dahiya A., Bioenergy: biomass to biofuels, Elsevier, 2015, ISBN: 978-0-12-407909-0		
Knowledge	Student has knowledge of waste management and the use of post-production and waste biomass.		
Skills	Student can recognize and select apply technology of biomass for energy purposes.		
Other social competences	Student is aware of further training and the need constantly expand knowledge on the use post-production and waste biomass.		

Course title	NUTZPFLANZEN DER TROPEN UND SUBTROPEN		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Marek Bury	**E-mail address to the person**	Marek.Bury@zut.edu.pl
Course code (if applicable)	WKSiR-2-48	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	german
Hours per week	2	**Hours per semester**	30
Objectives of the course	Die Studierenden erwerben detaillierte Kenntnisse über die bedeutendsten Nutzpflanzenarten, die Qualitätsanforderungen an ihre Produkte und ihre pflanzenbauliche Produktionstechnik, schwerpunktmäßig für ackerbaulich genutzte Arten in tropischen und subtropischen Klimazonen		
Entry requirements	Grundlegende Kenntnisse in Botanik, Pflanzenphysiologie und Pflanzenbau		
Course contents	Die kurze Charakteristik und Botanik und die allgemeine Vorstellung von Pflanzen, die aus tropischen Länder stammen (Mais, Sorghumhirse, Amaranthus, Sonnenblume, Kartoffeln, Hanf) oder in Tropen und Subtropen angebaut sind (Reis, Quinoa, Baumwolle, Manihot, Ölpalme, Zuckerrohr u.a.) Der Inhalt umfasst wirtschaftliche Bedeutung, Standortbedingungen (Boden- und Klimaverhältnisse) und die allgemeine Anbauverfahren von Pflanzen, die aus tropischen Länder stammen und in Europa angebaut sind (Mais, Sorghumhirse, Amaranthus, Sonnenblume, Kartoffeln, Hanf) und von durch den Studierenden gewählten Arten berichtet, die in Tropen und Subtropen angebaut sind. Als Beispiel kann hier Anbau von Reis, Quinoa, Baumwolle, Manihot, Ölpalme, Kaffee, Kakao, Tee u.a. genannt werden		
Assessment methods	Vorlesung / Multi-media Präsentationen Erkennung von einzelnen Arten Beurteilung von Präsentation / Projektes		
Recommended readings	1. Franke G, Nutzpflanzen der Tropen und Subtropen, Hirzel, Leipzig, 1982, 4. Aufl. 2. Rehm, S. & G. Espig, Die Kulturpflanzen der Tropen und Subtropen, Verlag Eugen Ulmer, Stuttgart, 1984 3. Bärtels A., Farbatlas Tropenpflanzen: Zier- und Nutzpflanzen, Verlag Eugen Ulmer, Stuttgart, 1989 4. Jenuwein H, Avocado bis Zuckerrohr: tropische Nutzpflanzen selber ziehen, Verlag Eugen Ulmer, Stuttgart, 1986 5. Caesar K., Einführung in den tropischen und subtropischen Pflanzenbau, DLG-Verlag, Frankfurt/Main, 1986		
Knowledge	Der Student hat Kenntnis von der Bedeutung von Nutzpflanzen der Tropen und Subtropen in der Weltwirtschaft und in der Wirtschaft Europas (Polens), beschreibt die in Europa angebauten tropischen Pflanzenarten		
Skills	Der Student ist in der Lage, die Grundsätze und die Bedeutung der Produktion von Nutzpflanzenarten der Tropen und Subtropen aufzuzählen und kann die geeignete Methode und Technologie des Anbaus wählen, die die Rentabilität der Produktion garantiert		
Other social competences	Der Studierende ist bewusst der Bedeutung und des Verständnisses der agrotechnischen Aspekte des Ingenieurwesens, einschließlich seiner Auswirkungen auf die Umwelt		

Course title	ORNAMENTAL PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Agnieszka Zawadzińska	**E-mail address to the person**	Agnieszka.Zawadzinska@zut.edu.pl
Course code (if applicable)	WKSiR-2-49	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Providing knowledge of assortment of ornamental plants cultivated in ground, their habitat requirements, cultivation and the use. Providing knowledge of propagation process and plant production . Providind knowledge and ability of use plants in terms in the design of green areas and interior.		
Entry requirements	Basic knowledge of plants structure, systematic, botany and physiology. Basics knowledge of soil science and plant fertilization		
Course contents	Bulbs, tubers and rhizome plants – characteristic of the species, groups and cultivars, requirements, cultivation and the use. Annual and biennial plants – characteristic of the species, requirements, cultivation and the use. Perennial – characteristic of the species, requirements, cultivation and the use. Occurrence of ornamental plants in the world Botanic and utility groups of ornamental plants Propagation of ornamental plants Bulbs, tubers and rhizome plants – structure and short characteristic of groups Annual and biennial plants – characteristic of groups Perennial – characteristic of groups		
Assessment methods	Lecture / multi-media presentation Demonstration - presentation of plant materials recognizing of plants project work written the test		
Recommended readings	1. Callaway D.J., Breeding of ornamental plants., Timber Press., 2009 2. Ifengspace – Guangzhou T., Ornamental plants in landscape., Phoenix Publishing Limited, Phoenix, 2012		
Knowledge	Student proposes appropriate for different groups of ornamental plants production technologies Student identifies and characterises the most important economically species and cultivars of ornamental plants.		
Skills	Student can choose the appropriate methods of production and formulate recommendation of cultivation for specific groups of ornamental plants. Student can choose the appropriate methods of propagation for particular plant species. Student is able to analyze and interpret the impact of agrotechnical factors on growth, development and yield of ornamental plants.		
Other social competences	Student is aware of the need for education and self-improvement in the use of new technologies.		

Course title	ORNAMENTAL PLANTS IN THE WORLD		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Agnieszka Zawadzińska	**E-mail address to the person**	Agnieszka.Zawadzinska@zut.edu.pl
Course code (if applicable)	WKSiR-2-50	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	To introduce students to the typical flora in the various geographical zones-plant and plant states. Indication of the origin of economically important ornamental plants To introduce students to the requirements of the plants, depending on the origin. Indication of the risks of over-exploitation of plants with natural sites		
Entry requirements	Basic knowledge of the geography and botanic		
Course contents	Ornamental plants zones Polish protected plants Plant nations – characteristic of plants that have decorative and utility value. Tropical rainforest. Plants in polish landscape. Mediterranean country plants. Characteristic and importance of palms- review of major species. Characteristic and requirements of succulents - review of major species. Ornamental aquatic and mud plants – origin, application.		
Assessment methods	informative lecture exposure projects method evaluation of the project written exam		
Recommended readings	1. Blundell M., Wild flowers of East Africa., Harper Colins Publishers, 1987 2. Chan E., Tropical plants., Periplus, 2000 3. Hardy D., Succulents of the Transvaal., Southern Book Publishers., 1992 4. Perry F., Flowers of the World., Optimum books., 1982 5. Warren W., Tropical flowers., Periplus., 1998		
Knowledge	The student knows the typical flora in the various geographical zones-plant and plant states, the main species of ornamental plants and there location in the world.		
Skills	The student is able to describe requirements the most important ornamental plants in relation to the origin.		
Other social competences	The student is aware of the continuous learning and expanding knowledge of the occurrence of plants and the threats present in the environment		

Course title	ORNAMENTAL POT PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Agnieszka Zawadzińska	**E-mail address to the person**	Agnieszka.Zawadzinska@zut.edu.pl
Course code (if applicable)	WKSiR-2-51	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Knowledge of the basic species pot plants available on the market. Selection of plants for interior and exterior (balcony). Rules of growing and caring for plants . Indoor plants for low, medium and high light locations. Rules of arranging pot plants.		
Entry requirements	Basic knowledge of the geography, botanic and phisiology plants		
Course contents	Characteristics of the most important species and cultivars of ornamental plants from family Agavaceae, Arecaceae, Araceae, Araliaceae, Begoniaceae, Bromeliaceae, Crassulaceae, Cactaceae, Dracenaceae, Gesneriaceae, Moraceae, Orchidaceae, Zamiaceae etc., available for flower markets. Propagation and cultivation of ornamental pot plants for interiors and balconies . Care of plants indoors. Application and arranging ornamental plants indoors and on balconies .		
Assessment methods	informative lecture exposure demonstration subject exercises written exam recognizing of plants report of the exercises		
Recommended readings	1. Chapman P., Davidson W., Martin M., Encyclopedia of houseplants., Published by Crescent Books, New York, 1987 2. Perry F., Flowers of the World., Optimum books., 1982 3. Warren W., Tropical flowers, Periplus., 1998 4. Crockett J.U., Foliage house plants., TIME LIFEBOOKS, Amsterdam., 1988 5. Beckett K.A., Encyclopedia of house plants., GALLERY BOOKS, New York., 1990 6. Chan E., Tropical plants., Periplus., 2000 7. Verteuil A., Burton V., Indoor gardens., Ebury Press, London, 1986		
Knowledge	The student knows and recognizes the variety of ornamental pot plant.		
Skills	The student explains how to grow, reproduce, maintain and arrange the pot plants in the interiors and balkonies		
Other social competences	The student is aware of the continuous learning and increasing knowledge of new species and cultivars of pot plants.		

Course title	PHOTOGRAPHY		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Ewa Miśkiewicz-Żebrowska	**E-mail address to the person**	Ewa.Miskiewicz-Zebrowska@zut.edu.pl
Course code (if applicable)	WKSiR-2-52	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Get to know the history of photography at a glance Familiarization with the hardware and the types of cameras, carriers of image information Understanding the settings of the camera in manual mode (sharpness, aperture, shutter speed) Understanding the rules of photographic composition and lighting Understanding the principles of rendering, computer processing and printing		
Entry requirements	Basic knowledge of optics and computer		
Course contents	guided performance and execution of photographs independent performance and execution of photographs discussion and credit History of Photography at a glance Repetytorium optics. Construction and components of cameras. Auxiliary equipment. Carriers of record (photographic film or CCD) Camera settings (sharpness, aperture, shutter speed) Photographic composition and lighting Rendering, computer processing and printing The use of photographs (advertising, science, art, hobby) Summary and credit		
Assessment methods	Information lecture illustrated with the use of multimedia techniques, presentation of equipment Practical methods: show Activating methods: the method of cases, situational method situational method, individual and group correction Overview of work, colloquium and credit Student knows some history of photography, construction of cameras, understands rules of composition and is able to execute some good photographs.		
Recommended readings	1. Miotke J., BetterPhoto Basics: The Absolute Beginner's Guide to Taking Photos Like a Pro, Amphoto Books, New York, 2010 2. Stone J., London B., A Short Course in Photography, Pearson, London, 2014, (8th Edition)		
Knowledge	Student knows some history of photography, construction of cameras, understands rules of composition and is able to execute some good photographs.		
Skills	Student correctly uses camera settings, composition and lighting,and methods of rendering, computer processing and printing		
Other social competences	Student is sensitive to manifestations of art in the surrounding reality, which uses to build his own creative attitude		

Course title	PHYTOREMEDIATION POTENTIAL OF AQUATIC PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Małgorzata Gałczyńska	**E-mail address to the person**	Malgorzata.Galczynska@zut.edu.pl
Course code (if applicable)	WKŚiR-2-53	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	The goals of this course are: 1) to understand the functioning of nutrient cycles in aquatic systems, 2) to understand the concepts of constructed wetlands, 3) to understand the concepts of restoration aquatic ecosystems Analysis of ammonia nitrogen (NH4-N), nitrate nitrogen NO3-N) orthophosphate (PO4-P), temperature, dissolved oxygen (DO) in contaminated waters		
Entry requirements	Basic knowledge of environmental chemistry		
Course contents	An aquatic plants in natural wetlands - field trip Determination of dissolved oxygen and pH in water Determination of nitrogen and phosphorus compounds in water Calculations of the effectiveness of removing contamination with metals and biogenic compounds Role of aquatic plants in environmental clean-up. Constructed wetlands. 1. Physical, chemical and biological processes in the soil and water environment with the usage of wetland plants (macrophytes). 2. Aquatic plants used in CWs. 3. Classification of constructed treatment wetlands. 4. Domestic and industrial wastewater treatment. 5. Stormwater treatment. 6. Sewage gardens – constructed wetlands for single family households. 7. Cost-effectiveness and environmental impact. 8. Removal efficiency. 9. Pilot project Polder Rochow. 10. Pilot project with Joachim Krüger Pflanzenkläranlagen GmbH. 11. Case study Vidrare - the vertical flown CW: design of the wastewater treatment, construction of the wastewater treatment, operation and maintenance, costs, other aspects		
Assessment methods	Multimedia presentations Discussion Laboratory exercises Assessment of the homework assignments Presentation - mitigation proposal for constructed urban aquatic habitats Reports of water analysis		
Recommended readings	1. Bhupinder Dhir, Phytoremediation: role of aquatic plants in environmental clean-up., 2013 2. Craig S. Campbell, Michael Ogden, Constructed Wetlands in the Sustainable Landscape, 1999		
Knowledge	Student gains theoretical and practical knowledge about constructed wetlands related to the circulation of elements in nature and their migration in the soil-water-plant system		
Skills	Student gains skills describes role aquatic plants, that are used in constructed wetlands. Moreover, he/she can do chemical analysis of water in hydroponic culture in environmental laboratories.		
Other social competences	Student demonstrates understanding of phenomena occurring in the constructed aquatic ecosystem. Student sees the need of self-development and further education. Furthermore, every student organizes and leads researches in a team. Students are responsible for ensured equipment.		

Course title	PLANT PHYSIOLOGY		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Jacek Wróbel	**E-mail address to the person**	Jacek.Wrobel@zut.edu.pl
Course code (if applicable)	WKSiR-2-54	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40
Objectives of the course	To acquaint students with physical and physiological processes that take place in plants. To learn relationships between the course of physiological processes in plants and internal and external (environmental) factors To use the physiological processes being learnt to increase plant productivity. To gain team work skills.		
Entry requirements	Basic knowledge of general biology, chemistry and physics		
Course contents	Diffusion, imbibition and osmosis processes. Determination of the osmotic potential of cell sap and transpiration intensity. Detection of starch in leaf blades and chromatographic analysis of assimilation pigment extract Detection of mineral chemical element in plant. Ionic antagonism. Physiological role and symptoms of the deficiency of chemical elemants in plants Effect of stimulators and inhibitors on plant growth and development Plant movements. Water balance of plant cells and plants. Gas exchange in plants (photosynthesis and respiration) Internal and external factors affecting the intensity of photosynthesis and respiration. Physiology of plant mineral nutrition. Growth and differentiation in plants. General characteristics of plant growth and development regulators Classification and importance of plant movements		
Assessment methods	Traditional lecture. Explanation, clarification Laboratory classes Demonstration, presentation Crediting the written reports from laboratory classes. Written test.		
Recommended readings	1. Taiz L., Zeiger E., Plant physiology and development, Sinauer Assiociates Inc. U.S., 2014 2. Jenks M.A., Hasegawa P.M. (Eds), Plant abiotic stress., Center for plants environmental stress physiology, Blackwell Publishing, Purdue University, Indiana USA, 2005		
Knowledge	A student defines and distinguishes basic physical and physiological processes that take place in plants. A students characterises internal and external factors affecting the physiological processes that take in plants. A student know chemical elements being assential for plants and explains their physiological function.		
Skills	A student performs measurement of basic physiological processes in plants, interprets results of these maesurments and draws coclusions. A student is able to use different sources of information and search in them for data to prepare a specific task in the field of plant physiology		
Other social competences	A student can work and co-operate in a group and take responsibility for the task performed.		

Course title	PLANT TISSUE CULTURES		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Danuta Kulpa	**E-mail address to the person**	Danuta.Kulpa@zut.edu.pl
Course code (if applicable)	WKSiR-2-55	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components, Explain the various steps taken to establish and optimise media for particular purposes in particular species, without the aid of texts Explain and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting. Establish and maintain plants in tissue culture and micropropagation, including morphogenesis Investigate and define a protocol to establish an unknown species and test its response Explain the various cell lines used in tissue culture and their origins and uses		
Entry requirements	Knowledge of plant anatomy and physiology would be advantageous.		
Course contents	Preparation of solid and liquid media. Preparation and sterilization of explants. Mass micropropagation of healthy plants. Callus and cell culture. Suspension cultures in bioreactor. Presentation from selective scientific papers. History of plant tissue cultures. Micropropagation (preparative stage, initiation of cultures, shoot multiplication, elongation and rooting, transfer to greenhouse condition). Somatic embryogenesis and artificial seeds. Callus and suspension cultures. Secondary product formation in suspension cultures. In vitro cultures in palnt breeding.		
Assessment methods	Lecture/multi-media presentation. Project method. Demonstration. project work essays		
Recommended readings	1. Bhojwani S.S., M. K. Razdan., Plant tissue culture: theory and practice., Elsevier science, 1996		
Knowledge	Students know the basic knowledge of plant tissue cultures.		
Skills	The student is able to prepare the media and set up a sterile culture in vitro.		
Other social competences	Student is able to work in a team of people growing plants in cultures in vitro.		

Course title	POSTHARVEST BIOLOGY AND TECHNOLOGY OF FRUITS AND VEGETABLES		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Kamila Bojko	**E-mail address to the person**	kamila-bojko@zut.edu.pl
Course code (if applicable)	WKSiR-2-56	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	Providing knowledge of storage methods of horticultural crops Providing knowledge of appropriate postharvest handling techniques for various fruit and vegetable species Shaping student ability to link quality changes in stored products with the methods and conditions of their storage		
Entry requirements	Basic knowledge of biochemistry, plant physiology, vegetable and fruit crops		
Course contents	Storage parameters for horticultural crops Changes occurring during storage - physical, chemical, biological, enzymatic and textural Changes in nutritional quality of fruits and vegetables during storage Quality characteristics of common fruits and vegetables according to their storage ability Storage methods / Controlled and modified atmospheres Chemical and physical treatments enhancing postharvest quality of fruits and vegetables Edible coatings Packing and packaging materials used for fruits and vegetables		
Assessment methods	Lecture / multi-media presentation Discussion Laboratory exercises Completion of the assignments Project method / report Performance in lectures and laboratories Assessment of the participation in the discussion Assessment of the homework assignments Assessment of laboratory work skills Report Final written exam		
Recommended readings	1. Paliyath G., Murr D., P., Handa A.K., Lurie S., Postharvest Biology and Technology of Fruits, Vegetables and Flowers, Wiley-Blackwell Publishing, USA, 2008 2. Wills R., McGlasson B., Graham D., Joyce D., Postharvest, UNSW Press, Syndney, Australia, 2007, 5th Ed.		
Knowledge	Student has knowledge of postharvest plant physiology, storage conditions and storage methods Student has knowledge of the treatments enhancing postharvest quality of horticultural crops and methods of preparing them for marketing		
Skills	Student has skills to adjust the specific methods and parameters of storage to the particular species of fruits and vegetables Student is able to assess the impact of the activities carried out during the storage process of horticultural crops		
Other social competences	Student is aware of the responsibility of high quality food production		

Course title	PRESENTATION TECHNIQUES		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Ewa Miśkiewicz-Żebrowska	**E-mail address to the person**	Ewa.Miskiewicz-Zebrowska@zut.edu.pl
Course code (if applicable)	WKSiR-2-57	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Understanding the rules of composition on the plane. Introduction to the lettering manual and mechanical. Editing text. Deliberate and conscious format text, create tables, graphs e.t.c. The acquisition of skills editing images, photographs, and drawings. Understanding the basic graphic programs. Formatting and paste illustrations to the text. The acquisition of skills graphical development projects, boards, posters. Basics of visualization and computer animation. Understanding the program presentation, slide show and diaporama.		
Entry requirements	Basic knowledge of photography and computer programs		
Course contents	The rules on the composition on plane. Introduction to the lettering. Ink, stencil, printing and computer lettering. Text editors. Formatting text, tables, charts and others. Work on picture. Graphic programs. Formatting and paste illustrations to the text. Introduction to the presentation graphics: The composition of single and multi-page. Graphic design projects, charts, visualizations. Computer animations. credit The rules on the composition on plane. Introduction to the lettering. Ink, stencil, printing and computer lettering. Text editors. Formatting text, tables, charts and others. Work on picture. Graphic programs. Formatting and paste illustrations to the text. Introduction to the presentation graphics: The composition of single and multi-page. Graphic design projects, charts, visualizations. Computer animations. credit		
Assessment methods	Information lecture illustrated with the use of multimedia techniques, presentation of equipment Practical methods: show Activating methods: the method of cases, situational method Situational method, individual and group correction Overview of work, colloquium and credit Student knows the rules on the composition on plane, text editors and graphic programs. Student is able to execute the presentation graphics.		
Recommended readings	1. Bowman Daria Price, Presentations: Proven Techniques for Creating Presentations That Get Results, F+W Publications Inc, Madison, 1998 2. Descriptions of programs: Microsoft Word, Sketchup, Corel Draw, Corel Paint, Adobe Photoshop, Power Point (Impress)		
Knowledge	Student knows the rules of composition on the plane, editing and formatting text, creating tables, graphs, formatting and pasting illustrations to the text. Basics of visualization and computer animation. Student understands the program presentation, slide show and diaporama.		
Skills	Student is able to compose the plane, can edit text, create tables, graphs, format and paste illustrations to the text. Student understands the program presentation, slide show and diaporama.		
Other social competences	Student is sensitive to manifestations of art in the surrounding reality, which uses to build his own creative attitude		

Course title	PRINCIPLES OF PLANT BREEDING		
Level of course	second cycle		
Teaching method	lecturing course / laboratory course / lecture		
Person responsible for the course	Stefan Stojałowski	**E-mail address to the person**	Stefan.Stojalowski@zut.edu.pl
Course code (if applicable)	WKSiR-2-58	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	40
Objectives of the course	Students will gain a general knowledge on methods currently applied in development and registration of plant cultivars		
Entry requirements	Basic knowledge on botany and genetics		
Course contents	Planning of field experiments and breeding nurseries Plant diseases – importance and methods of resistance breeding Lodging and pre-harvest sprouting in cereals – how to improve the resistance of plants? Assessment of plant fertility Efficiency of selection in plant breeding Marker Assisted Selection (MAS) in modern plant breeding Applicability of genetic engineering for breeding new cultivars Registration of cultivars – general rules Collection of plant material for molecular diagnostic. Freezing and liophylization of samples. Isolation of DNA from plant tissue Quality control of DNA samples, Polymerase Chain Reaction (PCR) with diagnostic primers Electrophoresis, visualization of amplified DNA fragments, interpretation of results Cultivar – definition, the role in modern agriculture. Systems of plant reproduction Source material for cultivar development Aims and methods of inducing mutagenesis and polyploidy Plant hybridization (within the species and between different species) – methods and significance for cultivar development Recombination and selection - basic methods of breeding new cultivars Heterosis and hybrid cultivars Biotechnology in plant breeding – current achievements and perspectives for future		
Assessment methods	Lecture Workshop Laboratory Written exam (test) Assessment of activity during workshops and labs		
Recommended readings	1. H. Kuckuck, G. Kobabe and G. Wenzel, Fundamentals of Plant Breeding, Springer Verlag, Berlin Heidelberg, 1991 2. W. R. Fehr, Principles of Cultivar Development, Macmillan Publishing Company, New York, 1987		
Knowledge	Students will gain knowledge about methods of hybridization and selection in plant breeding		
Skills	Students will gain skills with classic and modern methods of hybridization and selection of cereals and other important crops		
Other social competences	Student will know how to work within a team and know work safety regulations		

Course title	PROCESSING TECHNOLOGIES OF HERBAL PLANTS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Kamila Bojko	**E-mail address to the person**	kamila-bojko@zut.edu.pl
Course code (if applicable)	WKSiR-2-59	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	Providing knowledge of herb drying technologies according to the quality of the final herbal product Providing knowledge of the major herb products Shaping student ability to implement methodologies for the evaluation of quality and traceability of medicinal and aromatic plants		
Entry requirements	Student is expected to have laboratory practices and knowledge base about plant raw materials (biochemistry, microbiology)		
Course contents	Quality estimation of medicinal and aromatic plants according to pharmacopoeial requirements – organoleptic evaluation Quality estimation of medicinal and aromatic plants according to pharmacopoeial requirements – macroscopic evaluation Quality estimation of medicinal and aromatic plants according to pharmacopoeial requirements – microscopic evaluation Quality estimation of medicinal and aromatic plants according to pharmacopoeial requirements – physicochemical evaluation Preparation of raw plant material for drying process Parameters and methods of the drying process of herbs The effect of the drying process on the biologically active compound content Production of plant extracts Essential oil production Forms of herbal medicines		
Assessment methods	Lecture / multi-media presentation Laboratory exercises Completion of the assignments Project method / report Performance in lectures and laboratories Assessment of homework assignments Assessment of laboratory work skills Essay Report Written exam		
Recommended readings	1. Barnes J., Anderson L.A., Philipson J.D., Herbal Medicines, Pharmaceutical Press, London, Chicago, 2007, 3rd Edition 2. Handa S.S., Khanuja S.P.S., Longo G., Rakesh D.D., Extraction Technologies for Medicinal and Aromatic Plants, International Centre for Science and High Technology, Trieste, 2008		
Knowledge	Student has a knowledge of herb drying technologies - the methods and their influence on the quality of the final herbal product Student has knowledge of the major herb products - their production methods and properties Knowledge and understanding the European legislation involved		
Skills	Student is able to implement methodologies for the evaluation of quality and traceability of medicinal and aromatic plants		
Other social competences	Student is aware of the importance of different herb processing methods on the quality and medicinal properties of the final product		

Course title	PROCESSING TECHNOLOGIES OF WASTE FOR ENERGY PRODUCTION		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Grzegorz Jarnuszewski	**E-mail address to the person**	Grzegorz.Jarnuszewski@zut.edu.pl
Course code (if applicable)	WKSiR-2-60	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	0	**Hours per semester**	14
Objectives of the course	Knowledge of properties Municipial Solid Waste (MSW) and processing technologies. Students learn energy generation from Municipial Solid Waste and disposal of MSW by thermal and biological conversion.		
Entry requirements	Basic information on the waste management and waste processing.		
Course contents	Properties and composition of Municipial Solid Waste as a criterion for the use of thermal and biological conversion. Economic approach and environment impact of Municipial Solid Waste conversion methods Presentation of MSW processing technology (Waste incinerator) The composition and properties of Municipal Soild Waste. Division of thermal conversion methods of Municipial Solid Waste (MSW). Energy generation from Municipial Solid Waste by biological processing. Impact of processing methods of MSW to energy on environment.		
Assessment methods	Lectures/multimedia presentation laboratories/case method, demonstration elaboration test		
Recommended readings	1. Young G. C., Municipal solid waste to energy conversion processes. Economic, technical, and renewable comparisons., John Wiley & Sons Inc., New Jersey, 2010 2. 2. Integrated Pollution Prevention and Control, Reference Document on the Best Available for Waste Incineration, European Commission, 2006		
Knowledge	Student has knowledge of waste to energy conversion technologies.		
Skills	Student can recognize and select appropriate waste to converse to energy.		
Other social competences	Student has mind the rapid development of technologies conversion of waste to energy, and the need constantly expand knowledge in this area.		

Course title	PRODUCTION AND THE USE OF SOLID BIOFUELS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Marek Rynkiewicz	**E-mail address to the person**	Marek.Rynkiewicz@zut.edu.pl
Course code (if applicable)	WKSiR-2-61	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	1	**Hours per semester**	22
Objectives of the course	Student knows terminology related to solid biofuels. Student knows techniques and technologies convert biomass to biofuels.		
Entry requirements	Student knows the plants useful in the production of solid biofuels, understands the need for the use of biofuels as a renewable energy source.		
Course contents	Quality evaluation of the solid biofuels: a) determination of bulk density and tapped density, b) determination of moisture content, c) determination of length and diameter of pellets and briquettes, d) determination of mechanical durability of pellets, e) particle density determination of pellets and briquettes, f) determination of hardness of pellets and briquettes, g) determination of particle size distribution Solid biofuels: a) terminology, biofuel specification and classes, b) resources solid biofuels, c) the use of solid biofuels as an energy source, d) characteristic of solid biofuels, e) the production process of pellets and briquettes, f) solid biofuel quality assurance, g) lines for production of pellets and briquettes, h) roll press pelleting, i) briquetting and pelleting processes		
Assessment methods	Multimedia lecture Operation Instructions Practical tasks - demonstration Doing practical tasks Electronic test (grade) Reports (grade)		
Recommended readings	1. Ingwald Obernberger, Gerold Thek, The Pellet Handbook: The Production and Thermal Utilisation of Pellets, Routledge, 2010, ISBN: 978-1-84401-631-4, english version 2. PN-EN ISO 17831-1:2016-02. Solid biofuels -- Terminology, definitions and descriptions, 2016, english version 3. PN-EN ISO 17225-2:2014-07. Solid biofuels -- Fuel specifications and classes -- Part 2: Graded wood pellets, 2014, english version 4. PN-EN ISO 17225-3:2014-7 determines the fuel quality classes and specifications of graded wood briquettes, 2014, english version 5. PN-ISO 17225-6:2014-8 Solid biofuels -- Fuel specifications and classes -- Part 6: Graded non-woody pellets, 2014, english version 6. PN-EN ISO 17828:2016-02. Solid biofuels -- Determination of bulk density, 2016, english version 7. PN-EN ISO 17831-1:2016-02. Determination of mechanical durability of pellets and briquettes -- Part 1: Pellets, 2016, english version		
Knowledge	The student knows the terminology related to solid biofuels and knows the techniques and technologies for biomass conversion to biofuels.		
Skills	The student selects the machinery and equipment needed to process biomass for biofuels and is able to practically determine the physical parameters of solid biofuels based on standards.		
Other social competences	The student understands the need to use appropriate techniques and technologies in the production of biofuels while maintaining the quality parameters of biofuels		

Course title	QUALITY ASSESSMENT OF SELECTED HORTICULTURAL CROPS		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Kamila Bojko	**E-mail address to the person**	kamila-bojko@zut.edu.pl
Course code (if applicable)	WKSiR-2-62	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Providing knowledge of organoleptic and laboratory methods of horticultural crop quality assessment Shaping student skills to assess the quality of fruits and vegetables according to the current standards		
Entry requirements	Basic knowledge of biochemistry, vegetable and fruit crops		
Course contents	Chemical analyses of selected horticultural crops Classification (botanical and horticultural), origin, structure, and quality standards of main horticultural crops Quality features (appearance, texture, flavour, nutritive value and safety) of fruits, vegetables and herbs.		
Assessment methods	Lecture / multi-media presentation Laboratory exercises Completion of the assignments Project method / report Performance in lectures and laboratories Assessment of the homework assignments Assessment of laboratory work skills Report Test		
Recommended readings	1. Preece J.E., Read P.E., The biology of horticulture, John Wiley & Sons, Inc., USA, 2005 2. Picó Y., Chemical analysis of food. Techniques and applications, Elsevier, USA, 2012, 1st Ed.		
Knowledge	Student has knowledge of organoleptic and laboratory methods of horticultural crop quality assessment Student has knowledge of legal regulations applied for the quality estimation of horticultural products		
Skills	Student has skills to assess individually the quality of fruits and vegetables and give the conclusions of obtained results according to the current standards		
Other social competences	Student is aware of the influence of different internal and external factors on the quality of food		

Course title	RURAL LANDSCAPE		
Level of course	second cycle		
Teaching method	project course / field course / lecture		
Person responsible for the course	Magdalena Rzeszotarska-Pałka	**E-mail address to the person**	Magdalena.Rzeszotarska-Palka@zut.edu.pl
Course code (if applicable)	WKSiR-2-63	**ECTS points**	3
Semester	summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30

Objectives of the course	Making the student acquainted with the history of rural settlement development with particular emphasis on Western Pomerania. Acquisition of knowledge about the characteristic components of the rural landscape, the legal conditions in rural areas and methods of rural landscape revitalization. Acquiring the skills to develop a proposal for the revitalization of a rural landscape, on the example of a selected village, including the analysis of its existing condition, valorisation of the landscape and the study of spatial transformation of the village.
Entry requirements	Basics of landscape design. Basic knowledge of graphic methods in design.
Course contents	Methodology of landscape auditing in the protection of rural landscape. Development of a proposal for revitalization of the rural landscape on a example of a selected village. Performing an analysis of the existing condition, landscape valorization and a study of spatial transformations for the village. Preparation of preliminary functional and spatial guidelines for the selected area of the village and the initial concept of spatial development in this area, in line with its environmental, cultural and economic conditions. Presentations of student work on the revitalization of the landscape of selected villages. Characteristic features of village landscapes in Western Pomerania. Impact of large-scale economy on transformations of the rural landscape. An outline of the development of agricultural culture in the world and in Poland. Development of rural settlement in Poland, with particular emphasis on the area of West Pomerania. Characteristic constituents of rural landscape. Characteristic features of village landscapes in Western Pomerania. Impact of large-scale economy on transformations of the rural landscape and trends in the contemporary development of rural areas. Material administrative law regarding rural design. Provisions of a landscape resolution in rural areas. Principles for shaping and revitalizing rural landscapes.
Assessment methods	Information lecture illustrated with the use of multimedia techniques Project (design) method, case study Fieldwork (case study) Continuous assessment Intermediate presentations: mid-semester review Final evaluation of individual work (design)
Recommended readings	1. Rzeszotarska-Pałka M., Czałczyńska-Podolska M., Guidelines for revitalization of rural areas based on landscape studies, Czasopismo Techniczne, Kraków, 2019, tom 2. Rzeszotarska-Pałka M., Czałczyńska-Podolska M., Use of Landscape Audit Methodology for the Cultural-Aesthetic Values Evaluation (Case Study), Architektura Krajobrazu, Wrocław, 2018, tom 58 3. A. Szymski, M. Rzeszotarska-Pałka, J. Ignaczak-Felińska, Pomeranian village yesterday and today. Monograph of selected villages of West Pomerania, wyd. Walkowska, Szczecin, 2006 4. Kupidura A., THE ROLE OF LANDSCAPE HERITAGE IN INTEGRATED DEVELOPMENT OF RURAL AREAS IN THE CONTEXT OF “LANDSCAPE LEGAL REGULATION”, POLISH ACADEMY OF SCIENCES, Commission of Technical Rural Infrastructure, Kraków, 2017, III/1/2017
Knowledge	The student has knowledge about the history of rural settlement development, as well as the characteristic constituents of the rural landscape, legal conditions in rural areas and methods of rural landscape revitalization.
Skills	The student is able to develop proposals for the revitalization of rural landscape: perform analyzes of the existing condition, valorisation of the landscape and study of spatial transformations of village. Can formulate design guidelines and develop a preliminary concept of rural landscape revitalization.
Other social competences	The student is aware of the importance of social and professional responsibility for shaping the landscape of rural areas. The student is aware of the impact of various situational conditions on the process of lanscaping in rural areas.

Course title	SELECTION AND USE OF ORNAMENTAL PLANTS IN THEMATIC GARDENS		
Level of course	second cycle		
Teaching method	lecturing course / lecture		
Person responsible for the course	Agnieszka Zawadzińska	**E-mail address to the person**	Agnieszka.Zawadzinska@zut.edu.pl
Course code (if applicable)	WKSiR-2-64	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Gaining knowledge and skills of plants, their basic structure, habitat requirements and applicability in the design of green areas. Gaining knowledge and skills of the design space about varying functions using appropriate materials.		
Entry requirements	Students should know the basic assortment of ornamental plants, their requirements and decorative value.		
Course contents	Monoculture gardens, rose gardens, woodland and heather gardens, village gardens, sensory gardens, winter gardens - principles of the development and selection of plant species and cultivars to the selected type of garden. Project of thematic garden The criteria for selection of plants for landscaping and characteristics of thematic gardens. Monoculture gardens, rose gardens, woodland and heather gardens, village gardens, sensory gardens, winter gardens - basic information of structure.		
Assessment methods	Lecture / multi-media presentation Subject excercises project work		
Recommended readings	1. Robinson W., Darke R., The Wild Garden: Expanded Edition, Timber Press, Portland, Oregon., 2009 2. Swan J., Turning gardens into multisensory experiences, Nursing & Residential Care, 2011 3. Hussein H., An Exploratory Study of Sensory Gardens, http://premisejournal.blogspot.com		
Knowledge	Student knows the basic assortment of ornamental plants used for planting in different green areas. The student has a basic knowledge on how to use, cultivate and care of ornamental plants in different green areas.		
Skills	The student can recognize and make inventory of ornamental plants in the areas, as well as choose appropriate species and cultivars having their habitat requirements and decorative values. The student is able to determine the needs and guidelines for the selection of plants, their cultivation and care in themed gardens.		
Other social competences	The student is aware of the need of self-education and ready to work in team.		

Course title	URBAN LANDSCAPE		
Level of course	second cycle		
Teaching method	project course / field course / lecture		
Person responsible for the course	Eliza Sochacka-Sutkowska	**E-mail address to the person**	Eliza.Sochacka-Sutkowska@zut.edu.pl
Course code (if applicable)	WKSiR-2-65	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Acquiring theoretical knowledge and practical skills in the perception and assessment of the character of the urban landscape, through recognizing its structure, function and meaning. Developing students' awareness of the essence of the city and the importance of the urban landscape identity.		
Entry requirements	Knowledge of urban planning and landscape design at the level of the first degree of Landscape Architecture studies.		
Course contents	Visual assessment of the urban landscape. Diagnosis of sources of identity. Guidelines and conceptual proposals for the harmonization of selected problem sites. Perception and aestetic preference of the urban landscape. Urban spaces and open space sequence - perception and design principles. Selected methods of urban landscape research. Principles of creating urban composition. Functional and spatial structure of cities. Panoramas and silhouettes of the city. Visual elements of Landscape. Concept of the urban landscape identity.		
Assessment methods	problem lecture; discussion; presentation method; designing classes; classes in urban space Written exam with lecture content and literature Evaluation of practical works of the urban landscape, guidelines and proposals for spatial interventions. Assessment of the ability to capture the logic and structure of the city landscape in a synthetic, legible and coherent manner - ideogram "identity of the city landscape"		
Recommended readings	1. Lynch Kevin, The Image of the City, The MIT Press, 1960 2. Waldheim Charls, Landscape as Urbanism, Priceton University Press, 2016 3. Allan Tønnesen, InterSAVE : international survey of architectural values in the environment, Skov- og Naturstyrelsen, Copenhagen, 1997		
Knowledge	The student lists and characterizes selected concepts of the urban landscape research, knows the principles of valorization of urban space.		
Skills	The student is able to recognize and characterize urban composition and make visual assessment of the urban landscape, knows its individual elements and their role in landscape.		
Other social competences	The student notices the uniqueness and beauty of the urban landscape and understands their importance for building the city's identity.		

Course title	WATER AND WASTWATER TREATMENT		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Hanna Siwek	**E-mail address to the person**	Hanna.Siwek@zut.edu.pl
Course code (if applicable)	WKSiR-2-66	**ECTS points**	3
Semester	winter/summer	**Language of instruction**	english
Hours per week	1	**Hours per semester**	25
Objectives of the course	To give knowledge of different processes technology for present and future water purification and wastewater treatment, including construction, dimensioning and operation. Processes based on filtration and chemical precipitation, sludge treatment technologies, systems and methods for recovery of nutrients from sewage.		
Entry requirements	Taken at least one undergraduate course in general chemistry; Taken at least one undergraduate course in physics; Comfort with doing some math		
Course contents	Basic physical and chemical water and wastwater parameters - pH, dissolved oxygen, conductance, turbidity. Coagulation. Water treatment with iron salts Adsorption of organic contaminants on active coal. Adsorption models Aeration. Iron removal techniques (deferrization) Supply water characteristics, water quality, drinking water standards Conventional water and wastewater treatment processes: aeration, sedimentation, rapid mixing, flocculation, coagulation, filtration, disinfection, flouridation, water softening, turbidity removal, Advanced water and wastwater treatment processes: ion exchange, ozonation, adsorption, ultra filtration, membrane processes, UV disinfection, phosphorus removal, nitrogen removal (nitrification/denitrification),		
Assessment methods	multimedia lecture practical exercises Continuous asssessment, reports test discussion during the classes		
Recommended readings	1. Droste, R.L., Theory and Practice of Water and Wastewater Treatment, John Wiley & Sons, New York, 1997 2. 2. Kawamura, S., Integrated Design of Water Treatment Facilities, John Wiley & Sons, New York, 2000		
Knowledge	Student has knowledge of the physical, chemical, and biological water and wastewater treatment processes.		
Skills	Student understands the purpose, operation, underlying mechanisms, and basic design principles of common water and wastewater treatment processes		
Other social competences	Student understands contemporary water and wastewater treatment processes issues in a global and societal context.		

Course title	WATER CHEMISTRY		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Hanna Siwek	**E-mail address to the person**	Hanna.Siwek@zut.edu.pl
Course code (if applicable)	WKSiR-2-67	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	To introduce the student to a knowledge of physical and chemical parameters of water and processes that control the composition of water in environments. To illustrate elementary chemical water analysis and to provide the student with a knowledge of data interpretation.		
Entry requirements	Taken at least one undergraduate course in general chemistry; Taken at least one undergraduate course in physics; Comfort with doing some math		
Course contents	Environmental sampling of water Basic characteristics of water: turbidity, pH, conductance The properties of buffer solutions Acid-base indication of water alkalinity and acidity. Indication of corrosivity of waters. Determination of Water Hardness using Complexometric titration Spectrophotometric determination of nutrients: nitrogen (ammonia, nitrate, nitrite) and phosphorus compounds in water Interpretation of chemical analyses Physical chemistry of water. Hydrogen bonds. Physical states and properties of water. Chemical properties of water. Mineral and gas solubility. Environmental water buffers. Physical and chemical characteristics of water. Standard methods of water analysis. Kinds of environmental waters and their essential characteristics.		
Assessment methods	multimedia lecture practical exercises Continuous asssessment, reports test discussion during the classes		
Recommended readings	1. Mark M. Benjamin, Water Chemistry, Waveland Press, New York, 2014 2. Patrick Brezonik, William Arnold, Water chemistry, Oxford University Press, xford, 2011		
Knowledge	Student has the knowledge of basic processes in natural waters and the ability to assess the usage of surface waters in particular purpose based on results of chemical analysis		
Skills	Student has a working knowledge in hydrochemical laboratory and establishes the basic physical-chemical parameters in water		
Other social competences	Student understands water pollution issues in a global and societal context and collaborates and solves problems in group.		

Course title	БИЛКАРСТВО (BILKARSTVO)		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Dorota Jadczak	**E-mail address to the person**	Dorota.Jadczak@zut.edu.pl
Course code (if applicable)	WKSiR-2-68	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	bulgarian
Hours per week	2	**Hours per semester**	30
Objectives of the course	Дисциплината «Билкарство» дава основни познания за морфологията, систематиката и характеристиката на фитофармацевтичните свойства на лечебните растения. Студентите се запознават с видовото разнообразие на лечебните растения, суровините и тяхното разпознаване. Придобиват знания за съдържанието на биологично-активните вещества в билките, технологичните изисквания при събиране, сушене и съхраняване на лечебните растения и тяхната употреба.		
Entry requirements	Знания по ботаника, биохимия и физиология на растенията.		
Course contents	Ботаническо описание, разпространение, основни лечебни съставки, използване на: розмарин, босилек, майорана, бял и червен риган, градински чай, динка, градинскг чубрица, мента, коча трева, маточина, исоп, мащерка, естрагон, азмацук, резене, ким, кориандър, синап, магданоз, копър, девесил, обикновен анасон, лазаркиня, лопох, валериана, медицинска лайка, артишок, жълт кантарион, бял трън, културен лен, горски слез, арника, невен, индиански татул, вълнен напръстник, момина сълза, глухарче, коприва, полски хвощ, липа, дървовиден бъз. История и значение на лечебните растения в Полша. Биологично-активни вещества в лечебните растения и тяхното влияние върху човешкия организъм. Събиране, сушене, съхраняване и изисквания за качество на лечебните растения.		
Assessment methods	Лекции Обсъждане на проблема - дискусия, оценка на качеството на суровините Практически методи - разпознаване на растенията, идентификация на суровините Проект разпознаване на растенията, идентификация на суровините тест изпит		
Recommended readings	1. Николова А., Лечебни растения., Академично издателство на Аграрния университет, Пловдив, 2010 2. Митрев А., Попова С., Атлас на лечебните растения в България, София, 2011 3. Евстатиева Л., 10 технологии за отглеждане на билки, Фондация С.Е.Г.А., 2008		
Knowledge	След завършване на дисциплината студентът познава биологично активните вещества в лечебните растения. методи за събиранер сушение и съхраняване на суровини.		
Skills	Студентът знае как да употребява своите знания при събиране, обработка и употреба на основните лчебни растения.		
Other social competences	Студентът по одговорен начин решава проблеми свързани с работата с билковите растения.		

Course title	ЗЕЛЕНЧУКОПРОИЗВОДСТВО - 2 ЧАСТ (ZELENCUKOPROIZVODSTVO CAST 2.)		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Dorota Jadczak	**E-mail address to the person**	Dorota.Jadczak@zut.edu.pl
Course code (if applicable)	WKSiR-2-69	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	bulgarian
Hours per week	3	**Hours per semester**	45
Objectives of the course	Целта на курса по „Зеленчукопроизводство II част” е запознаване на студентите с методите на отглеждане на основните полски зеленчукови култури, стопанското им значение, ботаническата и биологичната характеристика, класификацията на сортовете.		
Entry requirements	Знания по ботаника, биохимия и физиология на растенията, общо зеленчукопроизводство.		
Course contents	Изисквания към сортовете на: домати, пипер, краставици, тикви, градински фасул, грах, бакла, зелеви култури (главесто зеле, цветно зеле, алабаш, савойско зеле, броколи), салати, спанак, лукови култури (лук, праз, чесън), морков, магданоз, целина, салатно цвекло, репички, аспержи, хрян, ревен. Значение, разпространение, класификация, ботаническо описание, технология на отглеждане : домати, пипер, краставици, тикви, градински фасул, грах, бакла, зелеви култури (главесто зеле, цветно зеле, алабаш, савойско зеле, броколи), салати, спанак, лукови култури (лук, праз, чесън), морков, магданоз, целина, салатно цвекло, репички, аспержи, хрян, ревен.		
Assessment methods	Лекции Упражнения текущ контрол оценка по проекта изпит		
Recommended readings	1. Чолаков Д. Т., Зеленчукопроизводство, Академично издателство на Аграрния университет, Пловдив, 2009 2. Карталов П. и д, Зеленчукопроизводство със семепроизводство, София, 1990 3. Михов, Кр., Н. Панайотов, Ст. Филипов, Т. Бабриков, Ръководство за упражнения по зеленчукопроизводство със семепроизводство, Пловдив, 2001		
Knowledge	След завършване на дисциплината студентът познава разлика в технологии на отглеждаане на основните зеленчукови култури в Полша и България=		
Skills	Студентът правилно прилаго съответната технология на отглеждаане на основните зеленчукови култури така в Полша, както и България. Познава изискванията към сортовете итн.		
Other social competences	Той е наясно с важността на производството и потреблението на зеленчуци в световен мащаб.		

Course title	ЗЕЛЕНЧУКОПРОИЗВОДСТВО - I ЧАСТ (ZELENCUKOPROIZVODSTVO CAST 1.)		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Dorota Jadczak	**E-mail address to the person**	Dorota.Jadczak@zut.edu.pl
Course code (if applicable)	WKSiR-2-70	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	bulgarian
Hours per week	2	**Hours per semester**	30
Objectives of the course	Целта на курса е запознаване на студентите с развитието на зеленчукопроизводството в Полша, хранителното значение на зеленчуците и основните изисквания при отглеждане на различни видове зеленчукови култури.		
Entry requirements	Знания по ботаника, биохимия и физиология на растенията.		
Course contents	Размножаване и разсадопроизводство на зеленчуковите растения, култивационни съоръжения в полското зеленчукопроизводство. Особености при торене на зеленчукови култури - изчисляване на торните дози. Схеми на зеленчукови сеитбообращения. Класификация на зеленчуковите растения. Изисквания на зеленчуците към основните екологични фактори: топлина, светлина, почвена и въздушна влажност, хранителен и въздушно-газов режим. Особености при обработката на почвата, торенето и напояването на зеленчуковите култури, борба с болести и насекоми. Теоретични основи и особености при прибиране, транспорт и сортиране на реколтата.		
Assessment methods	Лекции обсъждащи проблеми Упражнения - съвместна работа с преподавателя Презентация Текущ контрол Презентация Изпит		
Recommended readings	1. Чолаков Д. Т., Зеленчукопроизводство, Академично издателство на Аграрния университет, Пловдив, 2009 2. Михов, Кр., Н. Панайотов, Ст. Филипов, Бабриков Т., Ръководство за упражнения по зеленчукопроизводство със семепроизводство, Пловдив, 2001		
Knowledge	студентът познава класификация на зеленчуковите растения в Полша и България, биологичното им значение, изисквания на зеленчуците към екологичните фактори, методи на размножаване и основните мероприятия прилагани в зеленчукопроизводство по време на вегетационния период (обработка на почвата, прилагане на култивационните съоръжения, сеитбообръщения, борба с болести и неприятели, прибиране на реколтата и др.)		
Skills	Студентът притежава умения за практическо приложение на знанията си.		
Other social competences	Студентът осъзнава рисковетете и може да оцени значиние на вършената от него дейност в областта на зеленчукопроизводството		

Course title	ИНТЕГРИРАНО ПРОИЗВОДСТВО НА ЗЕЛЕНЧУЦИ И БИЛКИ (INTEGRIRANO PROIZVODSTVO NA ZELENCUCI I BILKI)		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Dorota Jadczak	**E-mail address to the person**	Dorota.Jadczak@zut.edu.pl
Course code (if applicable)	WKSiR-2-71	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	bulgarian
Hours per week	2	**Hours per semester**	30

Objectives of the course	Целта на курса по „Интегрирано производство на зеленчуци и билки” е запознаване на студентите с методите на интегрирано отглеждане на основните полски зеленчукови култури и билки, основни принципи при отглеждането им.
Entry requirements	Знания по ботаника, биохимия, физиология на растенията, зеленчукопроизводство.
Course contents	Технология на интегрираното отглеждане на избраните зеленчукови растения: домати, пипер, краставици, лук, моркови, ранни картофи, основни билкови растения. Същност и основа на интегрирано зеленчукопроизводство. Основни принципи в интегрираното зеленчукопроизводство, торене с органични торове, изграждане на балансирани сеитбообращения, естествено стимулиране на растенията, стимулиране на полезните насекоми и животни, алтернативни системи за борба с болестите при условията на интегрираното производство на зеленчуците.
Assessment methods	лекции упражнения презентация проект текущ контрол оценка по проекта оценка по презентация изпит
Recommended readings	1. Производство на биологични зеленчуци на открито, Биоселена, 2011 2. Атанасов Н. и др., Интегрирана защита на оранжерийните култури от болести и неприятели, Виденов и син & ПантаНес, 2005 3. Каров, Ст., Н. Панайотов, Андреев Р., Биологично производство на зеленчукови култури. Домати. Пипер. В: Хр. Янчева (ред). Наръчник по биологично земеделие, ИК “ВАП”, Пловдив, 2007 4. Попов Вл., Карова А., Биологично земеделие, Академично издателство на Аграрния университет, Пловдив, 2011
Knowledge	След завършване на дисциплината студентът придобива представа за същността и основни принципи в интегрираното зеленчукопроизводство.
Skills	Познава технологии на интегрираното отглеждане на избраните зеленчукови и билкови растения.
Other social competences	Студентът разбира значение на интегрираното производство на растителна храна за човека и околната среда.

Course title	СЕЛЕКЦИЯ И СЕМЕПРОИЗВОДСТВО НА ЗЕЛЕНЧУКОВИТЕ КУЛТУРИ /SELEKCIYA I SEMEPROIZVODSTVO NA ZELENCUKOVITE KULTURI		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Dorota Jadczak	**E-mail address to the person**	Dorota.Jadczak@zut.edu.pl
Course code (if applicable)	WKSiR-2-72	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	bulgarian
Hours per week	3	**Hours per semester**	45

Objectives of the course	Запознаване на студенти с генетични особености на зеленчуковите сортове, биологията на цъфтежа и опложданието, обработка на посевния материал, агротехнини и технологични принципи при зеленчуковото семепроизводство, изисквания на закона за посевния и посадъчен материал.
Entry requirements	Морфологични особености на семенниците; производство, съхраняване, подбор и засаждане на щеклинги при двегодишни зеленчукови култури.
Course contents	Физични свойства на семената. Окачествяване на семенния материал, сушене съхраняване на семената. Грижи за семепроизводителните посеви. Закон за посевния и посадъчен материал на РБ и релевантни актове от Европейското законодателство. Биология на цъфтежа, опрашването и оплождането при съответни видове зеленчукови култури. Семепроизводство на: зелеви зеленчуци, домати, пипер, краставици, моркови, целина, магданоз, салатно цвекло, лук, праз, фасул, грах, репички, спанак и салати. Морфологични особености на семенниците; производство, съхраняване, подбор и засаждане на щеклинги при двегодишни зеленчукови култури.
Assessment methods	лекции обсъждаши проблема упражнения - съвместна работа с преподавателя презентация текущ контрол оценка на презентацията на студента оценка на проекта писмен изпит
Recommended readings	1. Закон за посевния и посадъчен материал на РБ, 2011 2. Генков Г., Муртазов Т., Минков Ил., Зеленчукопроизводство със селекция и семепроизводствол София., София., 1994 3. Михов К., Панайотов Н., Филипов С., Бабриков Т., Ръководство за упражнения по зеленчукопроизводство със семепроизводство., АУ Пловдив, Пловдив, 2001
Knowledge	Студентът познава начини на семепроизводство на съответни видове зеленчукови култури, биология на цъфтежа, опрашването и оплождането, запознат е с морфологични особености на семенниците; производство, съхраняване, подбор и засаждане на щеклинги при двегодишни зеленчукови култури.
Skills	Студентът притежава практически умения при семепроизводство на отделните визове зеленчукови култури и окачествяване на семенния материал.
Other social competences	Студентът осъзнава рисковете и може да оценява значимостта на вършената от него дейност.

Course title	СЪБИРАНЕ НА ДИВОРАСТЯЩИ БИЛКИ (SYBIRANE NA DIVORASTYASTI BILKI)		
Level of course	second cycle		
Teaching method	laboratory course / lecture		
Person responsible for the course	Dorota Jadczak	**E-mail address to the person**	Dorota.Jadczak@zut.edu.pl
Course code (if applicable)	WKSiR-2-73	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	bulgarian
Hours per week	2	**Hours per semester**	30
Objectives of the course	Дисциплината «Събиране на диворастящи билки" дава основни познания за морфологията, систематиката и характеристиката на фитофармацевтичните свойства на диворастящите лечебни растения. Студентите се запознават с видово разнообразие на диворастящите лечебни растения, суровини и тяхното разпознаване. Придобиват знания за съдържанието на биологично-активни вещества в билките, изискванията при разпознаване, събиране, сушене и съхраняване на суровините и тяхната употреба.		
Entry requirements	Знания по ботаника, биохимия и физиология на растенията.		
Course contents	Фитосоциологично проучване на групите растения и оценка на местообитанието им. Описание, употребяема част, начин на бране и сушене, химичен състав и употреба на по важните диворастящи билки. Значение на диворастящите лечебни растения. Опазване на околната среда и правилен надзор при събиране на лечебните растения от природата, принципи за разумно събиране, срокове и начини на събирането. Местообитание на по-важните видове: влажни зони – езера, реки, брегове и наводнявани зони, влажни и блатнести почви, тресавища, влажни ливади; сухи зони - пасища, угари, земеделски земи, гори, поляни, храсти.		
Assessment methods	лекции упражнения проект оценка на проекта текущ контрол изпит		
Recommended readings	1. Канисков В., Лечебните растения в България - енциклопедичен справочник., София, 2011 2. Митрев А., Попова С., Атлас на лечебните растения в България, София, 1982 3. Николов С. (гл. Редактор), Специализирана енциклопедия на лечебните растения, Книгоиздателска къща Труд, 2006		
Knowledge	Студентът познава видове диварастящите лечебни растения и биологично активните вещества в тях, принципи здължаващи при събирането им свързано със защита на околната среда.		
Skills	Знае как да употребява своите знания при събиране, обработка и употреба на основните лчебни растения.		
Other social competences	Студентът е наясно с важността на лечебни растения събирани от околната среда, познава начини за опазване на околната среда и правилен надзор при събиране на лечебните растения от природата.		