Course name: Plant nutrition and fertilizers

ECTS	5
Course status	obligatory
Course final assessment /evaluation of outcomes	exam
Prerequisite	non

Main field of study:

Educational profile	general academic
Code of studies and education level	Bachelor
Semester of studies	summer
Language of instruction	English

Course offered by:

Name of faculty offering the course	Faculty of Agriculture and Economics
Name of department offering the course	Department of Agricultural and Environmental Chemistry
Course coordinator	Marcin Niemiec

Learning outcomes:

Symbol of outcome	Description of the learning outcome	Reference to main field of study outcomes	Area symbol*
KNOWLEDGE – student knows and understands			
PNF_W01	general issues about the role of nutrients in plants	RO1_W02	RR
PNF_W02	main sources of components in the soil and their forms of occurrence, chemicals transformations in the soil	RO1_W07	RR
PNF_W03	soil properties in terms of nutrient content	RO1_W07	RR
SKILLS – student is able to			
PNF_U01	assess the level of the content of ingredients in the plant and digestible ingredients in it soil	RO1_U16	RR
PNF_U02	determine the physicochemical properties of the soil, including soil acidity, sorption capacity	RO1_U10	RR
PNF_U03	determine the doses of mineral, natural and organic fertilizers, nutritional requirements of plants	RO1_U16	RR
SOCIAL COMPETENCIES – student is ready to:			
PNF_K01	work in teams of two to perform a laboratory exercise	RO1_K02	RR
PNF_K02	making decisions regarding plant fertilization in accordance with good agricultural practice and the principle of sustainable development	RO1_K03	RR

Teaching contents

Lectures	**15 hours**
Topics	1. Agricultural chemistry as a scientific discipline. Scientific theories applicable in agricultural chemistry 2. Elements necessary for the growth and development of plants 3. Division and role of nutrients (macroelements) in plant nutrition 4. Micronutrients - content and their physiological functions in living organisms 5. Mechanisms of nutrient uptake by plants 6. Soil environment and its properties 7. Physicochemical properties of the soil 8. Soil as a source of nutrients – macronutrients 9. Soil as a source of nutrients – micronutrients

	10. Transformations of nutrients in the soil 11. Natural and organic fertilizers. Classification, environmental impact, operation and use 12. Mineral fertilizers. Division, origin, production, properties and use 13. Biostimulants used in agriculture, division, operation, legal regulations 14. Fertilization of plants in soilless cultivation and vertical farming 15. The impact of fertilizers on the environment. Legal regulations regarding fertilization and fertilizers
Accomplished learning outcomes	*PNF_W01, PNF_W02, PNF_W03*
Means of verification, rules and criteria of assessment	*Written exam in the form of problem questions or in the form of a test (questions single choice) + participation in the discussion and Student activity. The condition for taking the exam is obtaining a positive grade for completing the exercises.* *At least 50% of correct answers must be given for a positive mark.* *Final grade of classes = 0.5 x grade from lectures + 0.5 x grade from exercises.*
Classes:	**40 hours**
Topics	1. Determination of soil pH and hydrolytic acidity using the Kappen method, calculation of lime dose 2. Determination of the cationic sorption capacity of soil 3. Determination of organic carbon content in soil using the Tiurin method 4. Determination of mineral nitrogen in the soil 5. Determination of the content of available phosphorus and potassium in the soil using the Egner-Rhiem method 6. Determination of the content of available forms of copper and zinc in the soil 7. Determination of nitrogen content in plant material by the Kjeldahl distillation method 8. Determination of the content of macronutrients (K, Na, Ca) in plants by flame photometry 9. Determination of the microelements content in plants by atomic absorption spectrometry 10. Determination of nitrogen content in nitrogen fertilizers using the formalin method 11. Determination of the content of water-soluble phosphates in superphosphate by titration method 12. Determination of chloride content in potassium fertilizers using the titration method 13. Determining doses of mineral and natural fertilizers for crops 14. Development of a fertilizer plan for the farm - nutrient balance
Accomplished learning outcomes	*PNF_U01, PNF_U02, PNF_U03, PNF_K01, PNF_K02*
Means of verification, rules and criteria of assessment	*Verification of the learning outcomes:* *- passing laboratory exercises,* *- exercise activity,* *- correctness of execution of exercises, correctness of calculations, interpretation of obtained results,* *The student's activity and involvement in performing the exercises are assessed laboratory. The share of the grade from exercises in the final grade: 50%.*
Field training:	**5 hours**

Topics	1. Field trip to the vegetation hall of the Department of Agricultural and Environmental Chemistry - learning about the methodology of vegetation experiments or 2. Trip to the Chemical and Agricultural Station in Krakow - learning about the methodology of laboratory analyses or 3. Trip to a selected fertilizer company - getting acquainted with the production and use of fertilizers

Accomplished learning outcomes	*PNF_U01, PNF_U02, PNF_U03, PNF_K01, PNF_K02*
Means of verification, rules and criteria of assessment	*Verification of the learning outcomes:* *- the basis for passing field exercises is to prepare a correct report classes*

References:

Basic	Mengel K., Kirkby E.A., Kosegarten H., Maathuis T.A. Principles of Plant Nutrition. Springer Netherlands, 2001. F.J.M. Plant Mineral Nutrients Humana Press Inc., 2016. Methods and Protocols Gorlach E., Mazur T. 2001. Chemia rolna. Wyd. PWN. Antonkiewicz J. /Red/. 2021. Przewodnik do ćwiczeń z chemii rolnej. Wyd. URK Kraków
Supplementary	Lityński T., Jurkowska H. 1982. Żyzność gleby i odżywianie się roślin. PWN. Filipek T. 1999. Podstawy i skutki chemizacji agroekosystemów

Structure of learning outcomes

Area of academic study:	5,0	ECTS

Structure of student activity

Contact hours		67	hrs.	2,7	ECTS**
Including:	lectures	15	hrs.		
	classes and seminars	45	hrs.		
	consultations	4	hrs.		
	participation in research		hrs.		
	obligatory traineeships		hrs.		
	participation in examination	3	hrs.		
e-learning			hrs.		ECTS**
student own work		58	hrs.	2,3	ECTS**

*Areas of academic study in the fields of: H- humanities; S - social studies; P – biological sciences; T – technological sciences; M- medical, sport and health sciences; R – Agricultural, forestry and veterinary sciences; A – the arts
** stated with an accuracy to 0.1 ECTS, where 1 ECTS = 25 - 30 hours of classes