Sustainable crop and livestock production and consumption
SYLLABUS

Study subject No:　　**1.2.**

Responsible Unit:　　**Latvia University of Life Sciences and Technologies, Latvia (LBTU)**

Credits and distribution of academic hours*:

	Credits ECTS	Contact hours		Independent study hours	Total hours
		Lectures	Practical works or seminars		
Course part I - VMU	3	14	13	63	90
Course part II - LBTU	3	14	13	63	90
Course part III - LBTU	1	6	3	21	30
Course part IV - JAMK	2	9	9	42	60
Total	**9**	**43**	**38**	**189**	**270**

* 1 ECTS = 30 hours (9 contact hours and 21 independent hours);
1 academic hour = 40 minutes;
Theoretical lectures not less than 50% of contact hours.

Course developers:

Course part I: Vytautas Magnus University, Lithuania (VMU), **Dr. Dovilė Levickienė**

Course part II: Latvia University of Life Sciences and Technologies, Latvia (LBTU), **Dr. agr. Diana Ruska**

Course part III: Latvia University of Life Sciences and Technologies, Latvia (LBTU), **Dr. agr. Diana Ruska**

Course part IV: JAMK University of Applied Sciences, Finland (JAMK), **PhD Gilbert Ludwig**

Notes: General study course for the master programme Bioeconomy.

Course part I

Prior knowledge: Knowledge of biology, chemistry, agronomy and ecology, Human Nutrition, Food Chemistry, Public Health Concepts, or similar course.

Annotation:
The course is designed to learn a wide range of theoretical issues on sustainable crop production, starting from the technological parameters of agricultural systems and environmental factors affecting the quality of crop products. Seminar classes and independent work develop students' skills to analyse the sustainable crops products technology, the quality of plant raw material for food, to identify and to apply food quality management systems, as well as to relate to consumer behaviour and education.

The aim:
Providing students with knowledge about sustainable crops production technology, acquiring professional skills in using their knowledge for sustainable production, addressing practical tasks, and analysing real situations, related with the safe and healthy food, and with consumption education.

Description of the organization and tasks of students' independent work:
The student has to complete an independent work about sustainable technology of one crop plant and present it in practical's.

Learning outcomes (knowledge, skills and competences)

Learning outcome	Assessment method	Level of achievement		
		Average	High	Very high
KNOWLEDGE				
Students will be able to: demonstrate knowledge about the classification of different crop production technologies.	Discussions in classes	Knowledge of the classification of different crop production technologies	Knowledge and understanding of different crop production technologies	Comprehensive knowledge of classification of different crop production technologies, their advantages or disadvantages for the environment pollution
Demonstrate the knowledge and understanding of sustainable crop products and the factors affecting quality of plant raw materials for food.	Discussions in classes, a test	Knowledge of the biotic and abiotic factors affecting quality of plant raw materials for food yet there is difficulty in understanding interaction among the productivity traits and factors affecting production. 40-69 % of the questions are answered correctly	Knowledge and understanding of the plant raw materials for food traits and the factors affecting quality and an ability to identify and analyse interaction of the most important traits. 70-89 % of the questions are answered correctly	Comprehensive knowledge of the plant raw materials for food traits and the factors affecting quality, interaction among traits and factors evaluation and management. 90-100% of the questions are answered correctly
Demonstrate knowledge about management systems for quality of plant raw materials for food and its effective and sustainable using related with consumer habits and their law and education	Practical works, a test	Knowledge about management systems for quality of plant raw materials for food, yet there is difficulty in understanding the strategic role of risk assessment on	Knowledge about management systems for quality of plant raw materials for food. 70-89 % of the questions are answered correctly	Knowledge and understanding of about management systems for quality of plant raw materials for food and its effective and sustainable using related with consumer habits

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		quality of plant raw materials. 40-69 % of the questions are answered correctly		and their law and education 90-100% of the questions are answered correctly

SKILLS

Professional skills

Assess the role of different crop production technologies for quality of plant raw materials	Discussions in classes, independent work	Knowledge of the key principles of crop production technology methods, yet there is difficulty in understanding principle to achieve the objectives of production	Knowledge and understanding of crop production technology and their role of applying to achieve the objectives of production; an ability to made decisions.	Ability to critically assess the conformity of crop production technology with the production situation, analyse and develop qualitative and safe plant raw materials concept
Apply and analyse the productivity traits of the crop products	Practical works	Ability to analyse crop products traits, yet there is a lack of understanding of interaction of productivity traits and factors and their effects on the quality of plant raw material for food	Ability to analyse and apply productivity traits, yet the application of the traits is not systematic and lacks a complex approach for the quality of plant raw material for food	Ability to systematically analyse productivity traits and complexly apply the most proper production technologies to develop sustainable plant raw material for food

Soft skills

Come up with creative solutions and reasonably discuss for sustainable crop production	Independent/group work, a presentation	Ability to solve practical sustainable crop production problems, yet there is no ability to come up with solutions to applying most argumented methods and difficulty in arguing the choice of the approaches and the expected results	Ability to explain the advantages and disadvantages of the production solutions found, yet the assignments are completed inaccurately, and argumentation is incomplete	Ability to apply the theoretical knowledge acquired and find solutions to sustainable crop production problems; argumentation is based on analyses and the regularities identified

COMPETENCE

Define, describe and analyse the elements of a sustainable crop production and comprehend the need for consumer consumption	Discussions, a test	Knowledge is insufficient and based only on facts; no understanding of the need to apply a sustainable	Ability to understand the need to apply a sustainable crop production approach and select and apply	Ability to define the need to apply a sustainable crop production approach in the well as select and apply the most

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		production approach	production technologies according to the sustainable objectives of production	proper technologies according to the sustainable objectives of the production and comprehend the need for consumer consumption

Requirements for awarding credit points: The student has to pass two tests, as well as complete and submit practical assignments performed during practicals, to complete an independent assignment and present it in practicals.

Knowledge assessment and prerequisites for taking a test or examination

The final mark in the course is based on cumulative score: Activity during lectures (10%), Activity during practicals/seminar (20%), 2 tests (20% each), individual independent work and a presentation (30%). 10% are equal to one point on a 10-point marking scale.

Topic	Type of assessment	Percentage*	Assessment deadline
Activity in lectures	Participation and activity in discussions	10	During the entire semester
Activity in practicals/seminar classes	Practical assignments during classes and at home	20	During the entire semester
Topics 1-5	Test	20	Within the specified time for the test
Independent work about the marketing environment and product promotion in the market	Individual independent work	30	Within the specified time for presentations
Topics 6-9	Test	20	Within the specified time for the test
Formal test with a mark		Cumulative score (100 points)	
Total		100	-

** 10 percent are equal to one point on a 10-point marking scale (or 10 percent are equal to 0.5 point on a 5-point marking scale).

The course part I content

1. Lectures

1. Characterization of crop production in Global and Central Asia. Connection of crop production sector with other agricultural branches and food sector.
2. Classification of agricultural crops.
3. Farming methods in crop production. Evaluation of crop products quantitative and qualitative traits.
4. Productivity traits of grains, vegetables, potatoes, fruits, uncommon plant for food rich in bioactive substances.
5. The factors of influence sustainable crop production productivity: biotic and abiotic factors.
6. Crop growing technologies: intensive, sustainable, ecological, biodynamic etc.
7. The functions of different fertilizers, their influence on the quality of plant raw material for food processing.

8. Requirements of quality evaluation of plant raw material for food. Methods and assessments.
9. Sustainable crop production and comprehend the need for consumer consumption.

2. *Practicals*

1. Quality and risk management principles in sustainable crop production. Crops growing methods in agriculture. Students prepare and estimate example of crop products evaluation. (1 h)
2. Evaluation of crop productive traits, analysis of the factors influencing traits. Students prepare database of productivity traits for future estimation and evaluation. (1 h)
3. Productivity evaluation methods and analysis for grain products. Analyses of productivity in wheat growing farming. Estimation and evaluation of parameters from prepared database. (2 h)
4. Productivity evaluation methods and analysis for vegetable. Analyses of productivity in vegetable growing farming. Estimation and evaluation of parameters from prepared database. (2 h)
5. Productivity evaluation methods and analysis for fruits. Analyses of productivity in fruit growing farming. Estimation and evaluation of parameters from prepared database. (2 h)
6. Fertilization ration complication and estimation according crop products cultivars and productivity (Evaluation of chemical composition by example of crop analyses. (3 h)
7. Students present individual works about one species of crop production technology. (3 h)

List of sources of training, methodological and scientific literature and information

Compulsory reading:
1. Miguel Costa. Food Safety and Quality System. Lincoln. 2015. DOI: 10.13140/RG.2.1.4306.5766
2. Roy R. N. et al. Plant nutrition for food security: guide for integrated nutrient management. Rome: Food and Agriculture Organization of the United Nations. 2006.
3. Manuela Zude. Optical Monitoring of Fresh and Processed Agricultural Crops. 2008. CRC.
4. A.Yassi, T. Kjellstrom, T. de Kok, T.L. Guidotti. Basic Environmental Health. 2001. Oxford University, by the WHO, ISBN 0-19-513558-X.
5. Sprenger R. A. The Foundation HACCP Handbook. 2nd Edition, Blackwell pub. 2007.
6. Brennan J. G. Food Processing Handbook. 2007.
7. Jeff Wu, Michael S. Hamada. Experiments: Planning, Analysis, and Optimization (Wiley Series in Probability and Statistics). 2009.
8. Naomi Modeste, Teri Tamayose and Helen Hopp Marshak. Dictionary of Public Health Promotion and Education: Terms and Concepts. 2004.

Further reading:
1. Theodore H. Tulchinsky, Elena A. Varavikova. The New Public Health– An Introduction for the 21st Century. Academic Press. 2009.
2. Building a common vision for sustainable food and agriculture: principles and approaches. Rome: Food and Agriculture Organization of the United Nations. 2014.
3. Biel, Robert. Sustainable food systems. London: UCL Press. 2016.
4. Gliessman, Steven R. Agroecology: the ecology of sustainable food systems. Boca Raton, Fla. : CRC Press. 2007
5. Стратегия развития сельского хозяйства Республики Узбекистан на 2020 — 2030 годы https://lex.uz/docs/4714635
6. О мерах по кардинальному обновлению государственной политики в сфере развития экономики и сокращения бедности. Указ Президента Республики Узбекистан от 26 марта 2020 года № УП-5975.
7. Повышение производственного и экспортного потенциала плодоовощной отрасли Узбекистана: проблемы и перспективы. Аналитический доклад, Ташкент-2016. (www.cer.uz).

8. Картофелеводство. Рекомендовано Координационным советом межвузовских методических объединений при Министерстве высшего и среднего специального образования Республики Узбекистан в качестве учебника для студентов магистратуры по специальности 5А620216- овощеводство. Ташкент 2005.

Periodicals and other sources:

1. Sustainability: https://www.mdpi.com/journal/sustainability
2. Agronomy: https://www.mdpi.com/journal/agronomy
3. Agronomy research: https://agronomy.emu.ee/
4. Folia Horticulture: http://ptno.ogr.ur.krakow.pl/Wydawn/FoliaHorticulturae/folia.htm
5. International journal of vegetable sciences: https://www.tandfonline.com/toc/wijv20/current

Course part II

Prior knowledge:
Biology of farm animals and animal physiology

Annotation:
The study course will give introduce students to the importance of animal husbandry in bioeconomy, characterization of branch, and sustainable development perspectives. Seminar classes and independent work develop students' skills to familiarizing themselves with the growth and development characteristics of different animal species, different animal breeding technologies, methods of estimation of productivity, and functions of nutrients in animal nutrition, and basic planning principles of feed rations.

The aim: Providing students with knowledge about farm animal origins production technology, acquiring professional skills in using their knowledge for sustainable production, addressing practical tasks, and analysing real situations.

Description of the organization and tasks of students' independent work:
The student has to complete an independent work about one species of livestock production technology and present it.

Learning outcomes (knowledge, skills and competences)

Learning outcomes	Assessment methods	Levels of achievement		
		Satisfactory	**Average**	**High**
KNOWLEDGE				
Students will be able to: demonstrate knowledge about classification of different farm animals and selection methods, organization of pedigree recording system	Discussions in classes	Knowledge of the most important farm animals' classification and selection methods	Knowledge and understanding of the farm animals' classification and selection methods, and organisation of pedigree recording system	Comprehensive of the farm animals' classification and selection methods, and organisation of pedigree recording system understanding of the role selection in the livestock production
Demonstrate the knowledge and understanding of livestock	Discussions in classes, a test	Knowledge of the relevant productivity traits	Knowledge and understanding of the productivity	Comprehensive knowledge of the productivity traits

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productivity traits and the factors affecting quality of production.		and the factors affecting quality, yet there is difficulty in understanding interaction among the productivity traits and factors affecting production. 40-69 % of the questions are answered correctly	traits and the factors affecting quality and an ability to identify and analyse interaction of the most important traits. 70-89 % of the questions are answered correctly	and the factors affecting quality, interaction among traits and factors evaluation and management. 90-100% of the questions are answered correctly
Demonstrate knowledge about livestock nutrition, feed rationing and its effective use.	Practical works, a test	Knowledge of livestock nutrition, yet there is difficulty in understanding the strategic role of feed ration influence on productivity. 40-69 % of the questions are answered correctly	Knowledge of livestock nutrition and feed rationing role of sustainable livestock production. 70-89 % of the questions are answered correctly	Knowledge and understanding of livestock nutrition and feed rationing role of sustainable production; an ability to reasonably discuss of the feed ration according to the production level. 90-100% of the questions are answered correctly
SKILLS				
Professional skills				
Assess the role of breeding methods for livestock production	Discussions in classes, independent work	Knowledge of the key principles of breeding methods, yet there is difficulty in understanding principle to achieve the objectives of production	Knowledge and understanding of breeding methods and their role of applying to achieve the objectives of production; an ability to make decisions on breeding	Ability to critically assess the conformity of breeding methods with the production situation, analyse and develop optimal breeding concept
Apply and analyse the productivity traits of the livestock production	Practical works	Ability to analyse productivity traits, yet there is a lack of understanding of interaction of productivity traits and factors and their effects on the livestock production	Ability to analyse and apply productivity traits, yet the application of the traits is not systematic and lacks a complex approach	Ability to systematically analyse productivity traits and complexly apply the most proper production technologies to develop sustainable production
Soft skills				

Discuss and come up with the solution for sustainable livestock production	Independent/group work, a presentation	Ability to solve practical livestock husbandry problems, yet there is no ability to come up with solutions to applying breeding and nutrition methods and difficulty in arguing the choice of the approaches and the expected results	Ability to explain the advantages and disadvantages of the production solutions found, yet the assignments are completed inaccurately, and argumentation is incomplete	Ability to apply the theoretical knowledge acquired and find solutions to livestock husbandry problems; argumentation is based on analyses and the regularities identified
COMPETENCE				
competence to choose quality and price-competitive livestock breeds, feeding and housing technology for sustainable production	Independ work, a presentation	Knowledge is insufficient and based only on facts; no understanding of the need to apply a sustainable production approach	Ability to understand the need to apply a sustainable production approach and select and apply production technologies according to the sustainable objectives of production	Ability to define the need to apply a sustainable production approach in the well as select and apply the most proper technologies according to the sustainable objectives of the production

Requirements for awarding credit points: The student has to pass two tests, as well as complete and submit practical assignments performed during practicals, to complete an independent assignment and present it in practicals.

Knowledge assessment and prerequisites for taking a test or examination
The final mark in the course is based on cumulative score: Activity during lectures (10%), Activity during practicals/seminar (20%), 2 tests (20% each), individual independent work and a presentation (30%). 10% are equal to one point on a 10-point marking scale.

Topic	Type of assessment	Percentage*	Assessment deadline
Activity in lectures	Participation and activity in discussions	10	During the entire semester
Activity in practicals/seminar classes	Practical assignments during classes and at home	20	During the entire semester
Topics 1-6	Test	20	Within the specified time for test
Independent work about one species of livestock production technology	Individual independent work	30	Within the specified time for presentations

Topic 7-13	Test	20	Within the specified time for test
Formal test with a mark	Cumulative score (100 points)		
Total	100	-	

* 10 percent are equal to one point on a 10-point marking scale

The course part II content

1. Lectures

1. Characterization of animal husbandry branch in Global and Central Asia. Connection of animal husbandry sector with other agricultural branches.
2. Classification of agricultural animals. Classification of livestock breeds. Selection principles in animal husbandry.
3. Breeding methods in animal husbandry. Pure breeding and crossbreeding. Evaluation of animal quantitative and qualitative traits. Breeding, its role in increase of production. Selection schemes. Pedigree recording systems.
4. Growth and development of farm animals, types of constitution, body conformation, body condition.
5. Productivity traits of dairy, meat and poultry livestock.
6. The factors of influence livestock productivity: genetic, physiological and environmental.
7. The livestock housing technologies, their role in sustainable production.
8. Technologies for keeping, welfare, and udder health of dairy animals.
9. Animal fattening technology: intensive, semi-intensive, extensive.
10. The functions of different nutrition, their changes in organism. Digestion of feed in animal's organism.
11. Quality and characteristics of forage in animal nutrition.
12. Principles of feed rationing for ruminants, poultry and horses.
13. Production costs, their optimization possibilities for livestock production.

2. Practicals

1. Selection principles in animal husbandry. Breeding methods in animal husbandry. Pure breeding and crossbreeding. Students prepare and estimate example of breeding evaluation (1 hour).
2. Evaluation of farm animal productive traits, analysis of the factors influencing traits. Students prepare database of productivity traits for future estimation and evaluation (1 hour).
3. Productivity evaluation methods and analysis for dairy livestock. Analyses of productivity in dairy farming. Estimation and evaluation of parameters from prepared database (2 hours).
4. Productivity evaluation methods and analysis for meet livestock and poultry. Analyses of productivity in meet farming. Estimation and evaluation of parameters from prepared database (2 hours).
5. Classification of forage, zootechnical and economic characteristics for the establishment of feed rations for different animal species. Evaluation of feed compounds by example of feed analyses (2 hours).
6. Feed ration complication and estimation according to livestock species and productivity (2 hours).
7. Economy of livestock production. Students prepare estimation of production costs and plan for their optimisation (2 hours).
8. Students present individual works about one species of livestock production technology (2 hours).

List of sources of training, methodological and scientific literature and information

Compulsory reading (books, scientific articles, online sources etc.):

1. Bourdon, R.M. Understanding Animal Breeding: Pearson New International Edition. Pearson education limited, 2014. 513 p.
2. The International Committee for Animal Recording. https://www.icar.org/
3. Mc Donald P., Edwards R.A., Greenhalgh J.F.D., Morgan C.A., Sinclair L.A., Wilkinson R.G. Animal Nutrition. 7th ed. Printed by Ashford Colour Press Ltd., Gosport, England, 2011. 692 pp. http://gohardanehco.com/wp-content/uploads/2014/02/Animal-Nutrition.pdf.
4. Livestock Science, published by Elsevier B.V. ISSN: 1871-1413, URL: https://www.sciencedirect.com/journal/livestock-science
5. National Research Council. 2001. *Nutrient Requirements of Dairy Cattle: Seventh Revised Edition, 2001*. Washington, DC: The National Academies Press. https://doi.org/10.17226/9825.
6. National Academies of Sciences, Engineering, and Medicine. 2016. *Nutrient Requirements of Beef Cattle: Eighth Revised Edition*. Washington, DC: The National Academies Press. https://doi.org/10.17226/19014.
7. National Research Council. 1994. *Nutrient Requirements of Poultry: Ninth Revised Edition, 1994*. Washington, DC: The National Academies Press. https://doi.org/10.17226/2114.
8. Journal of Animal Science. Published/ American Society of Animal Science. ISSN (printed): 0021-8812. ISSN (electronic): 1525-3163
9. Achieving sustainable production of milk. Volume 1: Milk composition, genetics and breeding. Edited by Dr Nico van Belzen. Burleigh Dodds Science Publishing Limited: 2017. 339 p

Further reading:

European Federation of Animal Science. [Online] [viewed 10.09.2021.] https://www.eaap.org/publications/

Periodicals and other sources:

1. Journal of Dairy Science. URL: https://www.journalofdairyscience.org/
2. Animal welfare and beef cattle production systems. [Online] [viewed 10.09.2021.] https://www.oie.int/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=1&htmfile=chapitre_aw_beef_cattle.htm
3. Animal welfare and dairy cattle production systems. [Online] [viewed 10.09.2021.] https://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/current/chapitre_aw_dairy_cattle.pdf
4. Animal welfare and broiler chicken production systems. [Online] [viewed 10.09.2021.] https://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/current/chapitre_aw_broiler_chicken.pdf
5. Guide to good farming practice. [Online] [viewed 10.09.2021.]. http://www.fao.org/3/ba0027e/ba0027e00.pdf

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Course part III

Prior knowledge: Biology

Annotation:
The study course will introduce students to the role of bees in the economy and ecology. Seminar classes and independent work develop students' skills to familiarizing themselves with honeybee and its subspecies, bee products, their use, organisation of the production of honey and other beekeeping products, organisation of apiary, bee feed, nectar plants, crop pollination.

The aim: Providing students with knowledge about organisation of the production of honey and other beekeeping products, acquiring professional skills in using their knowledge for sustainable production, addressing practical tasks, and analysing real situations.

Description of the organization and tasks of students' independent work: The student has to complete independent work during the course for completing practical tasks in classes.

Learning outcomes (knowledge, skills and competences)

Learning outcomes	Assessment methods	Levels of achievement		
		Satisfactory	Average	High
KNOWLEDGE				
Students will be able to: demonstrate knowledge about classification of bees	Discussions in classes	Knowledge of the most important bees classification	Knowledge and understanding of the bees classification and subspecies	Comprehensive of the bees classification and subspecies, understanding of the bees subspecies using for production
Demonstrate the knowledge and understanding of bee production and organisation of apiary.	Practical works, a test	Knowledge of the relevant beekeeping and production, yet there is difficulty in understanding of organisation of apiary. 40-69 % of the questions are answered correctly	Knowledge and understanding of the beekeeping and production and an ability to identify and analyse of the most important production steps. 70-89 % of the questions are answered correctly	Comprehensive knowledge of the beekeeping and production and, analyse of the production organisation and evaluation its efficiency. 90-100% of the questions are answered correctly
SKILLS				
Professional skills				
Assess the role of beekeeping methods for honey production	Discussions in classes, independent work	Knowledge of the key principles of beekeeping methods, yet there is difficulty in understanding principle to achieve	Knowledge and understanding of beekeeping methods and their role of applying to achieve the objectives of	Ability to critically assess the conformity of beekeeping methods with the production situation, analyse

		the objectives of production	production; an ability to make decisions organisation of apiary	and develop optimal honey production
Apply and analyse the organisation of apiary for the honey production	Practical works	Ability to analyse organisation of apiary, yet there is a lack of understanding of interaction of productivity traits and factors and their effects on the honey production	Ability to analyse and apply productivity traits, yet the application of the traits is not systematic and lacks a complex approach	Ability to systematically analyse productivity traits and complexly apply the most proper production technologies to develop sustainable production
Soft skills				
Discuss and come up with the solution for sustainable honey production	Independent/group work, a presentation	Ability to solve practical apiary problems, yet there is no ability to come up with solutions to applying breeding and nutrition methods and difficulty in arguing the choice of the approaches and the expected results	Ability to explain the advantages and disadvantages of the production solutions found, yet the assignments are completed inaccurately, and argumentation is incomplete	Ability to apply the theoretical knowledge acquired and find solutions to beekeeping problems; argumentation is based on analyses and the regularities identified
COMPETENCE				
competence to choose high-quality and competitive bee subspecies, beekeeping technologies for the production of specific beekeeping products	Independ work, a presentation	Knowledge is insufficient and based only on facts; no understanding of the need to apply a sustainable production approach	Ability to understand the need to apply a sustainable production approach and select and apply production technologies according to the sustainable objectives of production	Ability to define the need to apply a sustainable production approach in the well as select and apply the most proper technologies according to the sustainable objectives of the production

Requirements for awarding credit points: The student has to pass one test, as well as complete and submit practical assignments performed during practicals, to complete an independent assignment.

Knowledge assessment and prerequisites for taking a test or examination
The final mark in the course is based on cumulative score: Activity during lectures (10%), Activity during practicals/seminar (20%), 1 tests (30%), individual independent work (30%). 10% are equal to one point on a 10-point marking scale.

Topic	Type of assessment	Percentage*	Assessment deadline
Activity in lectures	Participation and activity in discussions	10	During the entire semester
Activity in practicals/seminar classes	Practical assignments during classes and at home	20	During the entire semester
Topics 1-9	Test	30	Within the specified time for test
Independent work	Individual independent work	30	Within the specified time for presentations
Formal test with a mark		Cumulative score (100 points)	
Total		100	-

* 10 percent are equal to one point on a 10-point marking scale (or 10 percent are equal to 0.5 point on a 5-point marking scale).

The course part III content

1. Lectures

1. The role of bees in the economy and in the ecosystem. The history of beekeeping.
2. Subspecies of honeybees. The importance, characteristics, tasks and methods of selection work.
3. Feed base of the honeybee. The honeybee feed sources.
4. Nectar, contributing factors to its formation and excretion.
5. Economically most important parasitic and nonparasitic diseases of the honeybee and pests of beekeeping. Diagnostics, prevention and limitation.

2. Practicals

1. Breeding of the honeybee, its genetic fundamentals, methods (selection, hybridization, and inbreeding) and organization. Breeding process in beekeeping.
2. Feed base of the honeybee; choice of feed and its impact on colony during its different stages.
3. Economically most important parasitic and nonparasitic diseases of the honeybee and pests of beekeeping. Diagnostics, prevention and limitation.
4. Precise technologies and methods of agriculture in beekeeping. Decision support systems in beekeeping and pollination, their practical application.

List of sources of training, methodological and scientific literature and information

Compulsory reading (books, scientific articles, online sources etc.):
1. Bush M (2011) The Practical Beekeeper: Beekeeping Naturally, X-STAR PUBLISHING COMPANY, p 670
2. Cramp D. (2008) A Practical Manual of Beekeeping, Spring Hill House, p 329
3. Kakhramanov B.A., *Isamukhamedov S.Sh, Kuldasheva F.H, Donyrov S.T, Rakhimjanova N.Z. "*Breeding indicators of Carniolan (Apis mellifera carnica Pollm) and Carpathy (Apis mellifera carpatica) honeybees".

E3S Web of Conferences 244, 02008 (2021) TPACEE-2021. https://doi.org/10.1051/e3sconf/202128403018 - P. 1-8.

Periodicals and other sources:
1. American bee journal, [Online] [viewed 10.09.2021.] https://americanbeejournal.com/
2. Deutches Biene journal, [Online] [viewed 10.09.2021.] https://www.bienenjournal.de/
3. Kraxotin N.F., Beekeeping in Uzbekistan. "Labor" publishing house, Tashkent, 1991
4. Kakhramanov B. A., Safarova F. E., Isamukhamedov S.I, Donayev X. A., Ergashev X. B. Basics of Beekeeping, Manual, Tashkent, 2021

Course part IV

Prior knowledge:
Understanding of basic sustainability concepts, basic understanding of climate change and the reasons thereof

Annotation: The study course introduces students to the most important topicalities in the agriculture, with a focus on food systems & security in the context of climate change, climate smart agriculture (CSA) and technological advances in smart farming technology (SFT). The course aims to deliver basic theoretical knowledge about world agriculture, as well as to give versatile analysis of future development. Sustainability evaluation of current food production chains and practices: benchmarking climate-smart food systems around the globe. The focus of the course is on challenges of agriculture, especially related to climate change, diversity of cropping and livestock systems, distribution of land resources, technological developments.
The course extends students observational field to the global scale and gives practical skills in the assessment of sustainable agriculture.

The aim: Providing students with basic knowledge on sustainable crop and livestock production and consumption through concepts of climate smart agriculture and smart farming techniques, acquiring professional skills needed to evaluate and plan sustainable food production chains, addressing practical tasks and analysing real situations, and preparing students for further studies and higher professional qualifications.

Description of the organization and tasks of students' independent work: The student will complete independent work, like benchmarking climate-smart and innovative food systems around the globe and evaluate their feasibility in regional/national context; identifying and evaluating the climate change related challenges of Uzbek agriculture; benchmark current developments and tools of CSA and SFT to improve sustainability and climate resilience of Uzbek agriculture.

Learning outcomes (knowledge, skills and competences)

Learning outcomes	Assessment methods	Levels of achievement		
		Satisfactory	Average	High
KNOWLEDGE				
Gain a deeper understanding of climate change impacts on sustainability of agriculture, food systems and food security, in both national and global context	Lecture & Discussion in classes	Knowledge, and ability to seek such knowledge, on climatic change, sustainability of agriculture, food systems and food security, yet there is	Knowledge, and ability to seek such knowledge, on climatic change, sustainability of agriculture, food systems and food security, a good	Knowledge, and ability to seek such knowledge, on climatic change, sustainability of agriculture, food systems and food security, a good

		difficulty in understanding the complex role of climate change in driving agricultural development	understanding of the complex role of climate change in driving agricultural development, yet there are difficulties in putting the knowledge into national context	understanding of the complex role of climate change in driving agricultural development, and ability to put this knowledge into national context
Ability to collect, benchmark and demonstrate comprehensive knowledge on the substance of food systems & security, CSA and SFT and their functions in building resilient and sustainable agriculture in the context of climate change	Discussion in classes, independent exercises	Knowledge, and ability to seek such knowledge, yet there is a lack of understanding of the role CSA & SFT have in development of sustainable agriculture	Ability to seek and analyse available resources and reasonable understanding of the role CSA & SFT have in development of sustainable agriculture, yet difficulties in putting the knowledge into national context	Ability to seek and analyse available resources and reasonable understanding of the role CSA & SFT have in development of sustainable agriculture, ability to put knowledge into national context
SKILLS				
Professional skills				
Assess the role of CSA in the development of sustainable & resilient agriculture and food production chain	Discussion in classes, independent exercises, field trip	Ability to analyse available resources, yet difficulties in understanding the concept of CSA and its role in developing sustainable & resilient agriculture and food production chains	Ability to analyse available resources, a good understanding of the concept of CSA and its role in developing sustainable & resilient agriculture and food production chains, yet difficulties to apply the task on national or regional level/scale	Ability to analyse available resources, a good understanding of the concept of CSA and its role in developing sustainable & resilient agriculture and food production chains, ability to apply the task on national or regional level/scale
Soft skills				
Analyse the role of innovative food systems and SFTs as tool to implement CSA, and identify both potential barriers and means to their implementation	Discussion & Exercise work in small group + presentation (1/group)	Ability to analyse available resources, yet there is a lack of understanding of the role that food systems and SFTs may play as tool to implement CSA	Ability to analyse available resources and a reasonable understanding of the role that food systems and SFTs may play as tool to implement CSA, yet difficulties to apply the task on national or regional level/scale	Ability to analyse available resources, a reasonable understanding of the role that food systems and SFTs may play as tool to implement CSA, demonstrated ability to apply the task to national or regional level/scale

COMPETENCE				
Identify creative solutions to implement CSA and/or sustainable food systems to improve food security in Uzbekistan	Discussion & Exercise work in small group + presentation (1/group)	The solution, and the presented knowledge, are insufficient or too generic, difficulties in relating to the larger, complex picture, difficulties to consider regional or national context.	The solution, and the presented knowledge, are feasible on a general level, but is to some extent pre-mature because it ignores some essential, complex relationships, especially in the regional or national context.	The solution, and the presented knowledge, are feasible, considering essential and complex relationships, also in the regional or national context.

Requirements for awarding credit points:
The student has to (pass one test, as well as) complete and submit individual practical assignments/exercises as well as a practical group assignment (presentation) performed during the practicals

Knowledge assessment and prerequisites for taking a test or examination:
The final mark in the course is based on cumulative score: Activity during lectures & practical's (20%), individual exercises (20%), test result (30%), and group exercise & presentation (30%)

Topic	Type of assessment	Percentage	Assessment deadline
Activity during lectures & practicals	Lectures & practical assignments during classes and at home	20	During the entire course
Individual exercises	Individual independent work	20	Within the specified time for exercise submission
Topics 1-3	Test	30	Within the specified time for the test
Group work & presentation	Independent Group work & presentation	30	Within the specified time for presentations
Formal test with a mark		Cumulative score (100 points)	
Total		100	-

* 10 percent are equal to one point on a 10-point marking scale (or 10 percent are equal to 0.5 point on a 5-point marking scale).

The course part IV content

1. Lectures

1. **Food systems & food security in the context of climate change**
   a. Introduction
   b. Climate change impact on food systems & security
   c. Impacts of food systems on climate-change
   d. Mitigation and adaptation
   e. Exercise: Evaluating the sustainability of the current food production chains and practices
      i. benchmarking the climate-smart food systems around the globe

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      ii. identifying innovative food systems e.g. urban food production, agro-forest systems and other solutions of efficient food production, in Uzbekistan context

2. **Climate Smart Agriculture**
   a. Climate change impacts on agriculture
   b. CSA Approach (CSA)
      i. Introduction
      ii. Dimensions of CSA
   c. Management for CSA
      i. Soil
      ii. Water
      iii. Energy
      iv. Crops
      v. Livestock & Aquaculture
   d. Exercise: Mainstreaming CSA – Identifying challenges & opportunities, removal of barriers in Uzbekistan

3. **Implementing climate-smart practices: Smart agriculture**
   a. Introduction to agricultural IoT (Internet of Things)
      i. a multidisciplinary view of precision farming
   b. Monitoring
      i. spatiotemporally explicit production of soil information
      ii. proximate & remote sensing
         1. Water management (surface modelling)
         2. Optimizing fertilization
         3. Crop health & yield monitoring
         4. Plant counts
   c. Data transfer & processing
   d. From actionable information to smart actions: Support to decision making
   e. Exercise: Sustainability impact of smart farming - Economic, environmental and social dimensions of smart farming in Uzbekistan

2. *Practicals*

1. Exercise: Evaluating the sustainability of the current food production chains and practices
   - benchmarking the climate-smart food systems around the globe
   - identifying innovative food systems i.e. urban food production, agro-forest systems and other solutions of efficient food production, in Uzbek context
   - Exercise: Sustainability impact of smart farming - Economic, environmental and social dimensions of smart farming in Uzbekistan
2. Exercise: Mainstreaming CSA – Identifying challenges & opportunities, removal of barriers in Uzbekistan
3. Group work/exercise & presentation. This exercise is about competence building: Integrating acquired knowledge, skills, abilities and attributes to identify creative solutions to implement CSA, and/or SFT and/or sustainable food systems to improve climate resilience and sustainability of food production and/or food security in Uzbekistan

List of sources of training, methodological and scientific literature and information

Compulsory reading (books, scientific articles, online sources etc.):

1. Sutton, W., Srivastava, J., Neumann, J., Droogers, P., & Boehlert, B. 2013. Reducing the Vulnerability of Uzbekistan's Agricultural Systems to Climate Change. 10.1596/978-1-4648-0000-9. Download: https://bit.ly/2WoCwfm [viewed 15.09.2021]

2. Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: **Food Security**. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. p 437-550. URL: https://www.ipcc.ch/site/assets/uploads/2019/11/SRCCL-Full-Report-Compiled-191128.pdf

3. Lipper, L. et al. 2018. Climate Smart Agriculture - Building Resilience to Climate Change. Part 1, p 3-74, URL: https://www.researchgate.net/publication/320372437_Climate-Smart_Agriculture_-_Building_Resilience_to_Climate_Change

4. FAO, 2018: Climate Smart Agriculture: Training Manual - A reference manual for agricultural extension agents (text only, excluding exercises). URL: http://www.fao.org/3/ca2189en/CA2189EN.pdf

5. Khan, N.; Ray, R.L.; Sargani, G.R.; Ihtisham, M.; Khayyam, M.; Ismail, S. Current Progress and Future Prospects of Agriculture Technology: Gateway to Sustainable Agriculture. Sustainability 2021, 13, 4883. URL: https://www.mdpi.com/2071-1050/13/9/4883

Further reading (facultative):

1. Asfaw, S., Lipper, L., McCarthy, N., Zilberman, D. & Branca, G. 2017. Climate-Smart Agriculture - Building Resilience to Climate Change. 10.1007/978-3-319-61194-5. Download: https://bit.ly/3EYEq7P [viewed 15.09.2021]

2. Castrignanò, A., Buttafuocco, G., Khosla, R., Mouazen, A.,- Moshou, D. & Naud, O. (Eds), 2020: Agricultural Internet of Things and Decision Support for Precision Smart Farming, Academic Press

3. FAO, 2021. Climate resilient practices. Typology and guiding material for climate risk screening. 36pp. URL: http://www.fao.org/publications/card/en/c/CB3991EN/