Module Handbook

The MSc: 70812302 – Land Raclamation and Irrigated Agriculture degree program

Name of the module/subject and code	**ITM5102- Research Methodology**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Yangiev Asror Abdikhamidovich, doctor of technical sciences, professor*
Language	*Uzbek, Russian*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 60 hours.* *Contact hours: 30 hours:* - *lecture – 20 hours;* - *practical lessons – 10 hours;* - *self-learning - 180 hours.*
Number of credits allocated to science	*2*
list of prerequisite subjects	*"Soil mechanics", "Grounds and foundations", "Irrigation and melioration", "Use of hydromelioration systems", "Water-saving irrigation technologies", "Hydrometry", "Hydraulics", "Construction mechanics", "Engineering construction", "Hydrotechnical constructions".*
Expected Learning Objectives	After mastering the discipline, the student will: **know and understand:** *-knowledge such as determining the unique features of the scientific research method and methodology, the proportionality of the scientist's intellectual capabilities and socio-economic conditions, the creative process of setting a problem in scientific creativity and finding its solutionto have insights about.* **Be able to:** *- to have the ability to scientifically analyze philosophical categories such as scientific research, explanation and understanding, problems and problematic situations, which are the main factors of the methodology of scientific creativity.* **form competences in:** *- to carry out scientific research and research in the field of science and to have an idea about scientific creativity;* *- to carry out scientific research and research in the field of science and to have and be able to use different conceptual approaches in the field of scientific creativity;* *- to conduct scientific research and research in the field of science and to have the skills of scientific creativity;*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Subjects and tasks of the science of scientific research methodology. Science and creativity. Science is one of the oldest objects of philosophy. The concept of creativity.Difficulty level: 2* *Scientific research methods, Theoretical research methodology, Experimental research methodology, Field research methodologyDifficulty level: 2* *Modeling problems in scientific creation. Concept of "modeling". Modeling problems in scientific cognition. The role of modeling and analogy in cognition. Similarity theory. Newton's law of similarity. Geometric similarity. Kitematic and dynamic similarity terms.Difficulty level: 3* *Analogy of hydrodynamic processes. From the Nave-Stokes equation to the criteria Fr, Re, Sh, Ei. Dimensional theory: basic concepts and principles, dimensional formulas.Difficulty level: 4* *Experiment planning: purpose, factors, types of experiments, randomization. Analysis of experimental data, tasks, differentiation and integration of obtained functions, comparison. finding functional relationships, tables, graphs, interpolation and extrapolation.Difficulty level: 5*
Exams and assessment format	*To fully master the theoretical and methodological concepts of science, to be able to accurately reflect the results of analysis, to independently observe the studied processes and to fulfill the assignments and assignments given in the interim control forms, to submit a written work for the final control.*
Study and examination requirements	*Students who successfully pass the science* *The total maximum marks will be the sum of the final exam (40%), Midterm (60%), and allotment points. To pass the subject successfully, the student must score 60% or more of the allotted points.*
Reading list	*1. Maidanov A.S. Methodology of scientific creation.-M., 2008.* *2. Zimnyaya I.A. Nauchno-issledovatelskaya rabota: methodology, theory, practical organization and implementation. - M., 2000.* *3. Rahmatullaev Sh. Fundamentals of scientific research. - T., 2002.* *4. Sabitov R.A. Basic scientific research. Uchebnoe posobie. - Chelyabinsk, 2002.* *5. Bakiev M., Majidov I., Nosirov B., Khojakulov R., Rahmatov M., Yangiev A. Hydrotechnical facilities. Tashkent, Intellect publishing house, 2022. 506 pages.*

Module designation	**MTD5I04 Ameliorative soil science**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*associate professor, Khakberdiev Obid Eshniyozovich*
Language	*Uzbek, Russian.*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*Soil Science and Agriculture, Plant Science, Ecology, Ameliorativ and Irrigation.*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- the general scheme of the soil formation process,* *- factors of plant life and agricultural laws; - basics of land reclamation:* *- the water regime of the soil active layer,* *- about melorization factors in zones of excess and insufficient moisture* **Be able to:** *- chemical composition of the soil,* *- soil colloids and soil absorption capacity;* *- soil structure, causes of its deterioration and methods of restoration;* *- soil water regime;* *- alien plants and their biological properties, methods of weed control;* *- the scientific basis of crop rotation, their classification and order of organization;* *- soil and basic, pre- and post-planting treatment; use of reclaimed land;* *- zonal systems of agriculture and their scientific basis* **form competences in:** *- agronomic zoning of soils,* *- soil inspection,* *- use of land cadastre data,* *- irrigation systems and their elements,* *- water sources for irrigation,* *- soil maps,* *- soil protection and their efficient use,* *- methods and techniques of irrigation of agricultural crops,* *- modern types of agriculture*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Factors and conditions affecting soil reclamation in irrigated farming region. Natural-climate, soil-ameliorative. hydrological-geographic, hydrogeological-ameliorative conditions. Erosion of soils under the influence of wind and water, desertification as a result of changes in climate conditions, rising of saline underground water to the surface of the soil, changes in the composition of cations in the soil absorption capacity, irrigation of cultivated plants with water containing a high proportion of dissolved salts. Level of difficulty: 1.* *Description of gypsum, barren, sandy, stony soils and methods of fertility restoration. Characterization of gypsum, barren, sandy and stony soils distributed in the irrigated agricultural region of the Republic, their level of productivity and their negative impact on crop production. Basic concepts representing the importance and nature of negative effects of agrotechnical, agrochemical, chemical and biological measures used to increase their productivity. Level of difficulty: 1.* *Methods of studying the causes, nature and complications of soil salinity. Description and classification of saline soils. Involvement of natural and anthropogenic factors in the distribution of saline soils in the irrigated agricultural region of the Republic. Soil salinity and soil fertility. Soil salinity and productivity of cultivated plants. Methods of studying soil salinity and negative complications. Level of difficulty: 2.* *Land reclamation zoning of the irrigated agricultural region. Theoretical and especially practical significance of zoning of soils with unsatisfactory reclamation status, essence, indicators taken into account in zoning: natural climate, main properties of soil cover, erosion, salinity, level of salinity, location of underground water and level of salinity, geobotanical description of soil cover and technical-economic indicators. Level of difficulty: 2.* *Modern approaches to studying and increasing productivity of land with an unsatisfactory state of reclamation. Theoretical, practical and technical-economic foundations of the restoration of the productivity of lands scattered in the irrigated farming region of the republic and the state of land reclamation is unsatisfactory. Procedures, norms and periods of stratified application of modern organizational-technological, agrotechnical, biological, chemical measures, which are carried out before the establishment and management of agricultural production in these lands. Level of difficulty: 3.* *Procedures and agro-technologies of farming on lands with unsatisfactory melioration status. Agro-technological measures that ensure the restoration of soil fertility in non-coniferous lands: tillage (main, before planting, between rows) including legumes, perennial grasses, timely application of organic and mineral fertilizers, taking into account the rapid system of farming and transfer in moderation. Level of difficulty: 3.*
Exams and assessment formats	*To fully master the theoretical and methodological concepts of science, to be able to accurately reflect the results of analysis, to independently observe the studied processes and to fulfill the assignments and assignments given in the interim control forms, to submit a written work for the final control.*
Study and examination requirements	*Students of successful transition from science* *The maximum points to be summed will consist of the final exam (40%), the interval control (60%),the sum of the points to be separated. In order to successfully pass the subject, the student must score 60% of the allotted points and collect a score in it..*

Reading list	*1. H.Atabaeva, O.Kadirhojaev. "Plantology" study guide. T. New Century Generation, 2006.* *2. Sh.Kholikulov, P.Uzokov, I.Bobokho'zhayev "Soil Science" Samarkand: "N.Doba" HT, 2011.* *3. A.Akhatov. "Soil resources and their use", T: TIMI publishing house, 2016.* *4. Ramazonov, S.Boriev. "Soil science and farming" T.: Barkamol fayz media, 2018.* *5. S.Kholnazarov. Encyclopedia of the young farmer. Tashkent., State scientific publishing house., 2019.*

Module designation	**MIU5104- Research methods in Land Reclamation**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Botirov Shavkat Chorievich, candidate of agricultural sciences, associate professor.*
Language	*Uzbek, Russian.*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*«Hydraulics», «Irrigation and reclamation», «Brine washing technologies».*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *-general rules on field experience;* *-phenological observations and various calculations in field experiments;* *- field experiments on tillage;* *- about the specifics of conducting experiments on planting methods* **Be able to:** *- to take into account the characteristics of the soil during the experiment;* *- characteristics of conducting field experiments on an eroded soils;* *- to carry out experiments with fertilizers;* *- to know how to take water samples and measure the level of water;* *- performance of agrotechnical measures in crop care;* *- conducting experiments in conditions of eroded soils;* *- to know the methods of conducting field experiments and researches in saline soils.* **form competences in:** *- the ability to carry out field experiments;* *- to have an idea of conducting scientific research work on the conditions of production of crops in the cotton-wheat complex;* *- learning to take soil samples and prepare them for analysis;* *- water sampling and determination of salts in water;* *- the ability to carry out phenological observations;* *- to analyse the results of scientific research.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*In scientific research, field experiments are the main method of researching various issues in agriculture. The main tasks of the field experiment are to provide a comparative scientific-agrotechnical and economic evaluation of the new methods or technologies being studied for introduction to production in different natural and economic conditions using the results of research in the laboratory, vegetation, lysimeter and small areas.* *Conducting basic scientific researches in melioration and irrigated farming with the help of laboratory, vegetative, lysimeter and field experiments. Difficulty level: 2* *Methods for determining the representativeness of field experiments. Uniqueness of field experience. Compatibility of the experimental field with the soil-climate (natural) and agrotechnical conditions of a certain region or zone. Conditions for conducting an experiment. Determining the representativeness of field experiments. Levels of compatibility of the experimental field with climatic, soil-hydrogeological and other conditions of the irrigated fields, district, region and republic. Difficulty level: 3* *The main requirements for conducting field experiments are the uniqueness of the experiment, compliance with the principle of single difference, conducting the experiment in a specially allocated area, taking into account the yield and the reliability of the experiment.* *Field and production experiences. Classification of field experiments and their classification. Field experience. Agricultural production experience. Basic elements of field experiments methods. Methodology for placement of experimental options. Field experience techniques. Number of options. Replication of the experience in the area. Experiment area, direction and shape of the plot.* *Difficulty level: 4* *The main stages of scientific research. Requirements for field work at the experimental site. Methodology of field experiments to determine the order of crop irrigation. Determination of water consumption of crops. FAO methodology* *Methodology of field experiments to determine the elements of crop irrigation technologies and irrigation techniques. Methodology of conducting phenological observations in field experiments. Features of conducting scientific research in saline and erosion-prone soils. Methods of conducting field experiments on salt washing. Determining the share of groundwaters in the water consumption of plants using lysimeter experiments. Reliability of scientific research results. Mathematical processing of the obtained data in the style of variational statistics. Difficulty level: 5*
Exams and assessment formats	*One written midterm assessments (30 minutes), take-home written assignments and one final oral exam (40 minutes).*
Study and examination requirements	*Requirements for successfully passing the module:* *The final grade in the module is composed of 40% performance on exams, 20 % independent work, 20 % practical work, 20 % mid-term control tests. Students must have a final grade of 60% or higher to pass*

Reading list	*1. Isaev S.Kh. and others. "Methods of scientific research in amelioration". Study guide. Tashkent. TIKXMMI printing house. 2019.* *2. Ritzema H.P. (Editor-in-Chief), 2006. Drainage Principles and Applications. Wageningen, Alterra, ILRI Publication no. 16, pp. 1125.* *3. Khamidov M.K., Soliyev B.K., Mukhamedov A.K. "Scientific research works in melioration and irrigated agriculture". Study guide. Tashkent, TIMI. 2008-176 pages.* *4. Nurmatov Sh.N, Mirzajonov Q.M. and others. - "Methods of conducting field experiments". Methodical guide. Tashkent 2007, page 147.*

Module designation	**MYR-5108-Recultivation and Land Reclamation**
Semester(s) in which the module is taught	*1,2.*
Person responsible for the module	*Khamidov Mukhamadkhan Khamidovich, DSc, Professor* *Begmatov Ilkhom Abduraimovich, PhD, Professor*
Language	*Uzbek, Russian.*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 240 hours.* *Contact hours: 120 hours:* - *lecture – 60 hours;* - *practical lessons – 60 hours;* - *self-learning - 60 hours.* - *Course projects: 1.*
Credit points	*8*
Required and recommended prerequisites for joining the module	*"Scientific Research Methodology", "Reclamation Soil Science", "Hydromelioration Systems Research", "Geoinformation Systems in Irrigation and Reclamation".*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- improvement of land reclamation status of different categories;* *- reclamation monitoring and reclamation cadastre;* *- recultivation of lands disturbed by anthropogenic and natural influences;* *- works performed during the implementation of the system of recultivation measures;* *- economic, ecological and social effectiveness of land reclamation.* **Be able to:** *- stages of land reclamation and recultivation;* *- melioration regime of irrigated lands;* *- design, construction and operation of hydromelioration systems;* *-water resources and their rational management and effective use;* *- man-made disturbed lands and directions of their recultivation;* *- restoration of agrogeosystems.* **form competences in:** *- melioration activities, design, construction and operation, repair-restoration and reconstruction of hydromelioration systems;* *- integrated management of water resources;* *- innovative solutions to land reclamation problems;* *- reclamation objects and directions;* *-implementation of measures of the technical and biological stage of recultivation;* *- recultivation of lands contaminated with chemicals, heavy metals, oil and oil products, as well as pesticides;* *- conducting research in the field of land reclamation and land reclamation.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*General concepts of melioration and land recultivation. Types of agricultural land. Soil monitoring and reclamation of agricultural lands. The state of salinity of irrigated lands in the republic. Water-physical properties of soils of irrigated lands Level of difficulty: 1.* *Tasks of land reclamation depending on natural and climatic conditions. Irrigation melioration. Irrigation systems. Watering methods. Conditions, advantages and disadvantages of using surface, sprinkler, drip, subsurface and aerosol irrigation. Elements of irrigation technique Level of difficulty: 1.* *Irrigation networks. Their water consumption, FIK and ways to increase it Level of difficulty: 2.* *Control of land reclamation conditions. Ameliorative cadastre. Water and salt balance equations of irrigated lands and their elements. Salt wash. Reclamation regimes of irrigated lands and methods of their management. Innovative solutions to the problems of land reclamation. Integrated management of water resources Level of difficulty: 3.* *General concepts about land reclamation. Objects of reclamation, natural state. Classification of disturbed lands. Stages of reclamation. Restoration of agrosystems Level of difficulty: 1.* *Issues to be solved in land recultivation. Objects and directions of reclamation. The content of works performed depending on the directions of recultivation and the requirements for the technical stage of recultivation. Activities of the biological stage of reclamation. Activities of the biological stage of recultivation for agricultural purposes. Land recultivation activities in the direction of forestry. Recultivation activities in the direction of water management Level of difficulty: 2.* *Recultivation of disturbed lands during the construction of linear structures. Reclamation of chemically contaminated land. Reclamation of lands contaminated with heavy metals. Recultivation of lands contaminated with oil and oil products. Reclamation of lands contaminated with pesticides. Restoration of agrogeosystems. Economic, ecological and social effectiveness of land reclamation Level of difficulty: 3.*
Exams and assessment formats	*One written midterm assessments (30 minutes), take-home written assignments and one final oral exam (40 minutes).*
Study and examination requirements	*Requirements for successfully passing the module:* *The final grade in the module is composed of 40% performance on exams, 20 % independent work, 20 % practical work, 20 % mid-term control tests. Students must have a final grade of 60% or higher to pass*
Reading list	*1. Xamidov M., Hamidov A., Botrov Sh. Melioratsiya va yerlarni rekultivatsiyalash. Darslik. —Toshkent. ТИҚХММИ босмахонаси. 2021. –290 bet.* *2. Хамидов М., Ҳамидов А., Исабаев К. Мелиорация и рекультивация земель. Учебник. Toshkent. "ТИИИМСХ", 2022. –295 стр.* *3. Голованов, А.И. Рекультивация нарушенных земель [Электронный ресурс], Москва, 2008.* *4. Стекольников К.Э., Гасанова Е.С. «Мелиорация и рекультивация земель». Учебное пособие. Воронеж, 2015.* *5. С.А.Касымбетова, А.И.Долидудко, Г.Т.Ахмеджанова. Рекультивация и охрана земель. Методическое указание. Ташкент. 2014.*

Module designation	**GTQ5104-Operation and Maintenance of Hydromeliorative Systems**
Semester(s) in which the module is taught	*2*
Person responsible for the module	*PhD Amanov Baxodir To'xtasinovich*
Language	*Uzbek, Russian.*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*«Hydraulics», "Hydro automatics», «Use of pumps and pumping stations».*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** - *It consists of a set of methods and tools that allow masters to automate the distribution of water in canals and manage water distribution without direct human intervention, or to facilitate the work of operational staff in distributing water between consumers,* - *knowledge bases in the automation of hydromelioration systems, improvement of the state of improvement of the existing hydromelioration network, mechanization and automation of water distribution processes, mechanization of work in production processes, having a vision of systematically increasing the yield of sustainable agricultural crops from meliorated areas by implementing complex water management activities.* **Be able to:** *to know the basics of various automatic devices used in the field of water management and land reclamation, their types,* - *scope of use, basis of calculation and their selection in accordance with specific conditions, as well as the methods of developing measures to improve the conditions based on the received information and be able to use them.* **form competences in:** - *In the automation of hydromelioration systems, it is necessary to have the skills to apply the methods of analysis of technical events and processes, to accept solutions to technical problems,* - *in the design of water-saving innovative techniques and technologies, the rules of construction standards and other normative documents,* - *the selection of modern innovative techniques and technologies, methods and elements of water-saving irrigation,* *finding technical and economic convenient options for placing irrigation networks.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Components of hydromelioration systems. Purpose and objectives of water use planning in irrigated agriculture. Level of difficult:2* *Use and automation of irrigation networks. Level of difficult:2* *Cluster, automation of crop irrigation on the farm, use and automation of irrigation networks. Level of difficult:3* *Plans for development and reconstruction in the use and automation of irrigation networks. Production and scientific research works on the use and automation of irrigation networks Level of difficult:5*
Exams and assessment formats	*One written midterm assessments (30 minutes), take-home written assignments and one final oral exam (40 minutes).*
Study and examination requirements	*Requirements for successfully passing the module:* *The final grade in the module is composed of 40% performance on exams, 20 % independent work, 20 % practical work, 20 % mid-term control tests. Students must have a final grade of 60% or higher to pass*
Reading list	*1. Brian Wahlin, Darell Zimbelman, "Canal Automation for Irrigation Systems" ASCE Publications. USA 2014.* *2. Serikbayev B, Dostnazarova S. "Use and automation of irrigation systems" Textbook. Tashkent TIIAME, 2020. – 258 p;* *3. Serikbayev B.S., Sherov A.G., Ibragimova H.R. "Modernization of hydromelioration systems", Textbook. Tashkent. "TIQHMMI" 2018y.-467 b;* *4. Baraev F.A., Serikbaev B.S. i second. Operation and automation of the hydromelioration system. Textbook. Tashkent. "TIMI", 2013. - 270 p.* *5. Automation of hydromelioration systems. Methodical instructions for conducting practical training in science. Tashkent-2020.*

Module designation	**IMG5104-Gio information system in Irrigation and Land Reclamation**
Semester(s) in which the module is taught	*2*
Person responsible for the module	*Professor Pulatov A.S.*
Language	*Uzbek, Russian.*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*«Geography», «Cartography»*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *The main object of this module is to enable the geoinformation system in the field of Irrigation and Melioration to analyze data, study problems, solve and assess situations, and to form appropriate knowledge and skills in geographic information systems.* **Be able to:** *To gain an understanding of map projection and georeferencing, geographic data visualization, global positioning systems, and spatial data infrastructure.* **form competences in:** *Knowledge of and ability to use ArcCatalog and ArcMap computer programs; (skill)* *should have the skills to perform geometric correction and geolinking of images, vector and raster operations. (qualification)*
Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Geoinformation Sytems in Irrigation and Melioration are to organize the data of the geo-information system of water management, to collect, store, manage, process, analyze and describe spatial-geographical data, and based on them to prepare a database necessary in Irrigation and Melioration. Level of difficulty: 2.*
Exams and assessment formats	*Two Midterm assessments (80 minutes each) and one final exam (80 minutes), take-home written assignments*
Study and examination requirements	*Requirements for successfully passing the module* *The final grade in the module is composed of 60% performance on exams, 20% take-home assignments, 20% in-class participation. Students must have a final grade of 60% or higher to pass*
Reading list	*Chang K.T., 2011. Introduction to Geographic Information Systems. Fourth Edition. McGRAW – HILL International Edition.*

Module designation	**TOS6104-Soil – plant - water relationship**
Semester(s) in which the module is taught	*3*
Person responsible for the module	*Saltanat Kasimbetova, Candidate of Technical Sciences, Associate Professor.*
Language	*Uzbek, Russian.*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*"Botany", "Biology", "Algebra", "Natural Science".*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- observation, analysis and measurement of types, properties, composition of soil, plants, water and the processes occurring in them with the help of equipment;* *- management of the water regime of the soil, determination of the volume and quality of water resources;* *-soil, plant, water dependence laws, plant species, changes in water demand during growth; - about the dependence of harvesting on water consumption, soil-ameliorative conditions.* **Be able to:** *- laws of connection between climate, soil, vegetation, water;* *- types of plants, salt-resistant plants, with the help of which to improve land reclamation;* *- water-physical properties of soils, their changes under the influence of water and plants;* *- the physiological role of water in plants.* **form competences in:** *- types of water in the soil and their role in plant life;* *- physiological characteristics of plants and resistance to salt;* *- distribution of water in the plant organism;* *methods of determining water demand and water consumption of plants;* *- the plant's ability to use soil moisture;* *- ways to ensure that the osmotic pressure in the cells of the plant root system is higher than the osmotic pressure of the soil solution and the ability to use them.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Introduction to the science of soil, plant, water dependence. Soil-ameliorative conditions of Uzbekistan, processes of soil formation and land fund. Difficulty level: 2* *Water-physical properties of soils, their changes under the influence of water and vegetation. Forms of water in soil. Movement of water in soil and plants. Physiological role of water in plants. Difficulty level: 2* *Methods of determining water demand and water consumption of plants. Adaptation of the plant root to the water regime of the soil. Difficulty level: 3* *Soil water evaporation property and soil water balance. Evaporation of water from the soil surface and plants. Movement of water in the soil-plant atmospheric system. Level of difficulty: 3* *Methods of determining the plant's demand for water, the water consumption of plants. The proportion of water in the plant and the soil. Determination of osmotic pressure in plant cells. Difficulty level: 4* *Regime of seepage waters and prevention of soil salinization. Methods for determining the concentration of cell sap in plant leaves. Using a tensiometer to determine moisture in soil layers. Difficulty level: 5*
Exams and assessment formats	*One written midterm assessments (30 minutes), take-home written assignments and one final oral exam (40 minutes).*
Study and examination requirements	*Requirements for successfully passing the module:* *The final grade in the module is composed of 40% performance on exams, 20 % independent work, 20 % practical work, 20 % mid-term control tests. Students must have a final grade of 60% or higher to pass*
Reading list	*1. Matyakubov B. Sh., Kasimbetova S.A., Bekmirzaev G.T. " Tuproq - o'simlik - suvga bog'liqlik" O'quv qo'llanma, TIQXMMI.2019. -150 bet.*

Module designation	**MFO 6102-Specific subjects teaching methods**
Semester(s) in which the module is taught	*3*
Person responsible for the module	*Ismailova Zukhra Karabaevna - doctor of pedagogic sciences* *Mustafaeva Durdona Asilovna - candidate of pedagogical sciences, associate professor*
Language	*Uzbek, Russian.*
Relation to curriculum	*Compulsory*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 60 hours.* *Contact hours: 30 hours:* - *lecture – 10 hours;* - *practical lessons – 20 hours;* - *self-learning - 30 hours.*
Credit points	*2*
Required and recommended prerequisites for joining the module	*«Vocational education methodology», «Pedagogical technologies and pedagogical skills».*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- to have an idea about the educational normative documents and methodical works of a special subject teacher, their planning, organization, implementation methodology;* *- the structure, laws and principles of the teaching process of special subjects, the tasks of the professor and the organization of students' educational activities in the process of teaching special subjects, methods and means of attracting students' attention and increasing the effectiveness of training, forms of teaching special subjects (lecture, seminar, practical, know and be able to use methods of laboratory, independent education, course work, graduation qualification work, educational practice and production efficiency improvement.* **Be able to:** *ability to develop didactic support of special subjects, prepare and implement training programs;* *to have knowledge and skills in the development of educational and methodological complexes of special subjects, the use of the rating system in the process of teaching special subjects;* **form competences in:** *drawing up the plan and technology of training in the teaching of special subjects, preparing the text of the lecture, the rules for preparing demonstration materials and multimedia, developing projects and cases related to the specialty, methods of conducting open trainings and formalizing documents, fully mastering the theoretical and practical concepts of the subject, accurately reflecting the results of analysis should have the skills of independent thinking about the studied processes.*

Content: The discipline includes. The level of difficulty: (1 – low, 5 high):	*It is the formation of methodical professional knowledge, skills and qualifications that will help masters to overcome the difficulties that arise in the process of education and upbringing of students during their future activities in the educational system, and to conduct general engineering, special technology and production education classes. Level of difficulty: 1.* *Formation of basic knowledge necessary for successful mastering of specialized subjects, "Pedagogical technologies and pedagogical skills", "Methodology of professional education", "Methodology of scientific-pedagogical research" and similar subjects, education based on the methodology of teaching subjects related to their field in masters conveying to the recipients, monitoring and analyzing the pedagogical process, using interactive methods in place, forming the skills of preparing the technological developments of classes, developing the ability to think analytically, work with information and systematize it. Level of difficulty: 2.*
Exams and assessment formats	*One mid-term control (20 minutes) in the form of an assessment and a final oral exam (40 minutes), a short computerized test is provided*
Study and examination requirements	*Students who successfully pass the science;* *The total maximum points will be the sum of the points allocated to the final exam (60%), Midterm control (20%), homework (10%) and activity in classroom activities (10%). To pass the subject, the student will be allocated 60% of points and above. must collect the amount.*
Reading list	*1. Ismailova Z.K.., Makhsudov P.M., Ergashev O.K., Matkarimov K.J. Methodology of teaching special subjects. Study guide, T.: "Navroz", 2019.* *2. Akimova O.B., Ismailova Z.K.., Maksudov P.M., Utkina S.N. Методика профессионального обучения. Учебное пособие. Т. "Navroz", 2020.* *3. Ismailova Z.K., Makhsudov P.M., Ergashev O. Methodology of teaching special subjects. Textbook. "Lesson Press" 2021.228 pages*

Module designation	**Sustainable Land Management**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Professor Pulatov A.S.*
Language	*Uzbek, Russian.*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical training*
Workload (incl. contact hours, self-study hours)	*Total load: 120 hours.* *Auditorium hours: 60 hours* *Lecture – 30 hours;* *Practical training 30 hours;* *Independent education - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*Ecology, Soil Science, Agriculture*
Module objectives/intended learning outcomes	***To know and understand:*** *The main object of this module is to provide graduate students with an understanding of the issues of sustainable land resource management. It is based on the knowledge of biophysical processes in the soil.* *to have an idea about soil components and the process of land deterioration (erosion, nutrient depletion and salinity);* ***To be able to:*** *to explain how various factors cause the increase of unstable land resources and to know and use them to determine the directions of actions to solve the problems of land degradation;* ***To form competences in:*** *should have the skills to give examples of successful strategies for managing sustainable land resources in various ecological zones and farming systems and to identify the biophysical, socio-economic factors that depend on their success;*
Content	*It takes into account economic and social factors that cause land degradation. Level of difficulty: 1.*
Exams and assessment formats	*Two Midterm assessments (80 minutes each) and one final exam (80 minutes), take-home written assignments*
Study and examination requirements	*Requirements for successfully passing the module* *The final grade in the module is composed of 60% performance on exams, 20% take-home assignments, 20% in-class participation. Students must have a final grade of 60% or higher to pass*

Reading list	*H. Eswaran, S. Berberoğlu, C. Cangir, D. Boyraz, C. Zucca (auth.), Selim Kapur, Hari Eswaran, Winfried E.H. Blum (eds.) - Sustainable Land Management_ Learning from the Past for the Future (2011)* *(Routledge Studies in Asia and the Environment) Victor Squires_ Lu Qi - Sustainable Land Management in Greater Central Asia_ An Integrated and Regional Perspective-Routledge (2019)*

Module designation	**GST5l04-Global climate and water supply**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Akmalov Shamshodbek Baxtiyarovich, PhD for technical sciences, docent.* *Kodirov Sobir Mamadiyorovich, senior teacher*
Language	*Uzbek*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*«Geography», «Geology», «Climatology», «Hydrology», «Physics».*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- laws of climate formation;* *- main geographical and circulation factors;* *- classification,* *- distribution of climate indicators on the surface of the earth;* *- to have an idea about changes;* **Be able to:** *- identification and analysis of factors affecting climate change;* *- change of solar energy in the atmosphere and geographical distribution of radiation;* *- annual change of the heat balance of the earth's surface and its components;* *- temperature changes and geographical distribution, - precipitation, humidity, evaporation, wind effects and the ability to use modern means of their determination;* **form competences in:** *- organization of hydrological and metrological studies and observations;* *- analysis and assessment of factors affecting climate change;* *- calculation of heat balance and its components, - use of modern metrological instruments and tools and acquire skills to solve other climatic problems.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Introduction to the science of "Global climate and water supply", Climate formation processes, Methods of studying global climate and its changes, Global and regional climate systems, External and internal factors of climate formation, Atmospheric circulation in climate formation. Level of difficulty: 1.* *Distribution of climate indicators on the globe, geographical factors of climate, solar radiation and energy balance, radiation and heat balance of the Earth's surface, climate classification and zoning processes. Circulation indicators in climate formation, climate classification. Meso and microclimate. Level of difficulty: 2.* *Distribution of climate indicators on the planet Earth, methods of climate restoration, current changes, anthropogenic influences. Climate of Central Asia and its changes, consequences of climate change. Impact of climate change on weather. Level of difficulty: 2.* *Distribution of water resources by river basins and their study. Impact of climate change on water resources. Changes in the hydrological regime of water bodies, their distribution throughout the year. Level of difficulty: 3.* *Methods of determining and calculating water balance elements, input and output elements, importance of climate for the activity of the national economy, study of climate indicators related to the activity of economic sectors, anthropogenic influence on global and regional climate. , the concept of global warming. Possibility of climate recovery. Level of difficulty: 3.*
Exams and assessment formats	*two oral Midterm assessments (20 minutes each) and one final oral exam (40 minutes), short computer-based quizzes, take-home written assignments*
Study and examination requirements	*Requirements for successfully passing the module e.g. the final grade in the module is composed of 60% performance on exams, 10% quizzes, 10% take-home assignments, 10% in-class participation. Students must have a final grade of 60% or higher to pass*
Reading list	*1. Akbarov A., Nazaraliev D., Djumbaeva G. Climate science. Study guide TIMI. 2015 114 pages.* *2. Petrov Yu.V., Egamberdiev Kh.T., Aloviddinov M., Kholmatjonov B.M. Climate science. University. Textbook. Tashkent: Publisher, 2010. 168 p.* *3. Akbarov A., Nazaraliev D., Abdullaev H. Textbook of meteorology. TIMI. 2008 154 pages.*

Module designation	**Reclamation hydrogiology**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Ph.D., Associate Professor Nurjanov Satbay Eshjanovich* *Ph.D., associate professor Ruziev Ilkhom Makhmudovich*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*“Physics”, “Chemistry”.*

Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- to analyze the hydrogeological conditions of the irrigated areas;* *- to calculate the regime and balance of seepage waters;* *- - assessment of geological and hydrogeological conditions of land, underground water flows, their prediction;* *- making hydrogeological maps,* *- drilling techniques and technologies, drilling equipment, drilling methods used in geological and hydrogeological research* **Be able to:** *- use in hydrogeological-ameliorative maps;* *- knowledge of negative processes and events that occur during the implementation of meliorative measures, and their prediction; - to prevent possible negative processes; assessment of hydrogeological improvement conditions of irrigated lands, results of geological and hydrogeological maps and studies,* *-hydrogeological indicators of underground water flows and aquifers and their use in solving reclamation issues,* *- negative events and processes related to the implementation of melioration and water supply measures,* *- basic physical and physical-mechanical parameters of soils, equipment of wells,* *- -opening of aquifers, aquifers, well construction, filters, preparation of filters, calculation of basic parameters* **form competences in:** *- specific aspects of geological and hydrogeological conditions* *- drilling methods, several methods of groundwater flow estimation,* *- prediction of changes in hydrogeological conditions,* *- geological and hydrogeological maps and research results, hydrogeological dimensions of aquifers and underground water flows,* *- methods of establishing the water balance of the region, hydrogeological data of observations, conducting hydrogeological and engineering, geological researches,* *- able to clearly state their opinions and conclusions regarding the analysis of research results and their use,* *- assessment of hydrogeological-ameliorative conditions,*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*- Tasks and content of reclamation hydrogeology in the reclamation of agricultural lands, urban and industrial areas. General information about irrigation and drainage. Elements of hydromelioration systems. Irrigation methods and water injection technology. Tasks of studying the hydrogeological-ameliorative conditions. Factors of hydrogeological-ameliorative conditions: Level of difficulty: 2.* *- General concepts and definition of hydrogeological process stages. Development laws of hydrogeological processes and their analysis in land reclamation. Factors determining hydrogeological processes (climate, relief, geomorphological, geological factors) and their description. Hydrogeological regions and their hydrodynamic description, regions of feeding and transit, consumption, re-reduction and spread of streams: Level of difficulty: 2.* *- Mode types. Natural and disturbed modes. Syzot water regime genetic types. Characteristics of seepage water regime distributed in different natural regions and irrigation areas. Regime of mineralization and chemical composition of Sizot waters. Principles of management of the regime of seepage waters. Water balance in land under reclamation. Balance types. Total water balance, aeration zone balance, seepage water balance. Balance components. Studying the balance and researching the balance plots. Analysis of the balance sheet: Level of difficulty: 2.* *- Factors of formation of irrigation nutrition during irrigation and salt washing. Specificity of irrigation nutrition in different climatic regions. Basing irrigation nutrition on the basis of modeling moisture transport in the aeration zone. Damping of seepage water in newly irrigated lands: Level of difficulty: 3.* *- Hydrodynamic indicators and boundary conditions necessary for land reclamation assessment, forecasting, and the design of reclamation structures. Hydrodynamic indicators - definition of their concepts. Methods of determining hydrodynamic parameters. Division into hydrogeological - reclamation districts. Definition of concepts; division into regional and local districts, taking into account the specificity of the hydrogeological process in the arid climate region and the distribution of stormwater in the regions. Geofiltration schemes of reclamation lands, general concepts about filtration schemes, a brief history of the issue. Geofiltration sections: Level of difficulty: 3.* *The role and importance of boreholes in irrigation and water supply systems. Concepts of drilling wells and their main elements. A brief history of drilling techniques and technology in Uzbekistan and abroad. Development of drilling science. The connection of this science with other sciences. Basic requirements for a drilling well. Types of rocks by drilling, sedimentary, igneous, metamorphic rocks and their properties. Types of damage to rocks during drilling: Level of difficulty: 4.* *The main factors determining the design of the borehole. The elements of the construction of the borehole: wellhead, conductor, diverter, technical, operational and strainer pipelines. Justification of the choice of water-absorbing operational layer. Basic information on the hydrogeological calculation of the Burgi well. Determination of borehole indicators based on experimental water withdrawal results. Taking into account the interaction of drill wells: Level of difficulty:* *- Strainers of boreholes. The main elements of strainer strings. Reasons for strainer failure. Perforated filters for catching small particles: perforated, various, wire, gravel, etc. Filter selection and their calculation. Structure of salniks. Strainer wells. Conditions of use, specific features of the device. Perforated filters for catching small particles: perforated, various, wire, gravel, etc. Filter selection and their calculation. Structure of salniks. Strainer wells. Conditions of use, specific features of the device: Level of difficulty: 5.*

Exams and assessment formats	*One midterm control (20 minutes) and final oral exam (40 minutes).*
Study and examination requirements	*Students who successfully pass the science* *The total maximum points awarded will be the sum of the points allocated to the final exam (60%), Midterm (20%), homework (10%) and classroom activity (10%). In order to successfully pass the subject, a student must score 60% or more of the allotted points.*
Reading list	*1. Yusupov G.U., Kuvvatov D.A. Study guide on reclamation hydrogeology - Tashkent "TIQXMMI" MTU 2015-250 b* *2. Yusupov G.U., Kuvvatov D.A. Reclamation hydrogeology fanidan amaliy mashғulotlarni bazharish bўyicha services kўrsatma- Toshkent 2015-100 b*

Module designation	**Engineering hydraulics**

Semester(s) in which the module is taught	*1*
Person responsible for the module	*Docent, Otakhanov M. Y.*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 60 hours.* *Contact hours: 30 hours:* - *lecture – 10 hours;* - *practical lessons – 20 hours;* - *self-learning - 30 hours.*
Credit points	*2*
Required and recommended prerequisites for joining the module	*"Physics", "Mathematics", "Hydrometry", "Terrestrial Hydrology", "Theoretical Mechanics", "Hydraulics"*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- it is necessary to have knowledge of performing hydraulic calculation of simple and complex pipes;* *- it is necessary to have knowledge of hydraulic calculation of channels;* *- it is necessary to have the knowledge to carry out hydraulic calculation of mud pressure and washing processes in channels;* *- it is necessary to have knowledge about the stable non-uniform movement of liquid flow;* **Be able to:** *- it is necessary to have knowledge of the classification of aqueducts and their hydraulic calculation;* *- Must have knowledge of hydraulic jump process, hydraulic jump function and its graph construction.* **form competences in:** *- it is necessary to know how to independently perform hydraulic calculations on the stable smooth and uneven movement of water in open valleys;* *- must be able to perform hydraulic calculation of hydrotechnical facilities independently;* *- it is necessary to know the connection of pipes, the hydraulic calculation of the energy quenching pool.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*• the student is doing from the science program, but mastered, cannot explain the topic of science, has an idea about science (subject), but cannot tell or express it. Level of difficulty: 2* *• understands and knows the essence of science, tells some aspects, has an idea about science (topic). Level of difficulty: 3* *• understands, knows and can tell the essence of science, can apply the acquired knowledge in practice, the student observes independently, has an idea about science (topic). Level of difficulty: 4* *• understands, knows and can tell the essence of science, has the ability to apply the acquired knowledge in practice, can think creatively, can observe independently, has the ability to make conclusions and decisions. Level of difficulty: 5*
Exams and assessment formats	*One midterm (60 minutes) and final oral exam (60 minutes), short computerized test, written homework and self- study.*
Study and examination requirements	*Requirements for successfully passing the module* *The total maximum points awarded will be the sum of the points allocated to the final exam (40%), Midterm (20%), homework (10%), classroom activity (10%) and independent study (20%). In order to successfully pass the subject, a student must score 60% or more of the allotted points.*
Reading list	*А.М.Арифжанов. Гидравлика. Тошкент 2022.* *А.Л.Зуйков. Гидравлика. Том 2. Напорные и открытые потоки. Гидравлика сооружений. Москва 2017.* *И.В.Качанов. Гидравлика,гидрология,гидрометрия. Минск 2017.* *Н. В.Васильева. Гидравлика гидравлические расчеты открытых потоков и сооружений. Горки 2022.* *А.Арифжанов, Қ.Рахимов, А.Ходжиев Гидравлика. Тошкент. ТИМИ 2016й. – 189б.* *А.Арифжанов, Х.Файзиев, А.Тошхўжаев «Гидравлика», Тошкент, Фан ва технология, 2019й.-366 б.* *Латипов К.Ш., Арифжанов А.М., Файзиев Х «Гидравлика», Тошкент, ТАҚИ, 2015 й.-459 б.* *Melvyn Kay “Practical Hydraulics”, Taylor & Francis, 2008y.-253 pages.* *T.Kaletova, A.Arifjanov “Hydromechanika”, Nitra, 2019y, -160 pages.* *А.М.Арифжанов, П.Н.Гурина, Т.У.Апакхужаева “Гидравлика”, Тошкент, ТИҚХММИ, 2018г, -171 с.*

Module designation	*Ecological modelling*
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Professor Pulatov A.S.*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical training*
Workload (incl. contact hours, self-study hours)	*Total load : 60* *Auditorium hours: 30* *Lecture - 10 hours;* *Practical training 20 hours* *Independent education 30 hours*
Credit points	*2*
Required and recommended prerequisites for joining the module	*Ecology, Geography, Basics of Statistics.*
Module objectives/intended learning outcomes	***To know and understand:*** *to have an idea about ecological modelling elements, modelling processes, model types, evaluation parameters, ecological modelling theory;* ***To be able to:*** *to know and be able to use ecological systems and their changes as a result of various influences, to model these changes based on physical and mathematical formulas, to implement models through computer programs, and to draw conclusions based on the results;* **To form competences in:** *must have the skills to conduct lectures and propaganda work within the boundaries of his professional activity;*
Content	*As a result of studying the science of "Ecological Modelling", undergraduates will be able to learn about ecological systems, their changes as a result of various influences, to model these changes based on physical and mathematical formulas, to implement models through computer programs and to draw conclusions based on the results. it is required to know how to conduct. Level of difficulty: 2.*

Exams and assessment formats	*Two Midterm assessments (80 minutes each) and one final exam (80 minutes), take-home written assignments*
Study and examination requirements	*Requirements for successfully passing the module* *the final grade in the module is composed of 60% performance on exams, 20% take-home assignments, 20% in-class participation. Students must have a final grade of 60% or higher to pass*
Reading list	*(Developments in Environmental Modelling 23) Sven Erik Jørgensen and Brian D. Fath (Eds.) - Fundamentals of Ecological Modelling-Academic Press, Elsevier (2011).*

Module designation	**Patenting, licensing and certification**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Turkmenov Khasan Ishimovich, candidate of technical sciences, associate professor*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 60 hours.* *Contact hours: 30 hours:* - *lecture – 10 hours;* - *practical lessons – 20 hours;* - *self-learning - 30 hours.*
Credit points	*2*
Required and recommended prerequisites for joining the module	*"Mathematics", "physics"; "chemistry", "basics of metrology", "standardization and certification".*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- to know the methods of patentability of inventions, features of patent legislation in leading industrial countries;* **Be able to:** *- to have the skills of comparative analysis of new technical solutions with analogues and creation of description and formulation of the invention;* **form competences in:** *- to have competencies in searching and analyzing patent information, drawing up international applications and foreign patenting, the main types of license agreements and their use.*
Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Understanding of intellectual property objects. Two areas of intellectual property rights. Legislation of the Republic of Uzbekistan in the field of protection of intellectual property objects.* Level of difficulty: 2 *Drawing up an application for patenting inventions. Drawing up applications for patenting industrial designs.* Level of difficulty: 3 *Drawing up applications for trademark registration. Certification overview. Legal basis of certification.* Level of difficulty: 4 *Carrying out patent research. Examination of patentability of inventions. International patent systems. Licensing of intellectual property objects.* Level of difficulty: 5
Exams and assessment formats	*1 intermediate control of scientific lectures is conducted in oral form, it consists of 3 questions and 30 min is allotted for it.* *Short computerized tests are conducted 3 times (each test lasts 20 minutes and consists of 30 test questions* *The final control will be conducted in written form, 4 questions will be asked and 40 min will be allocated.* *Homework is provided for practical training.*

Study and examination requirements	*In order to successfully pass the course, students must collect the following points* *The total maximum points will be the sum of the points for the final exam (60%), Midterm control (20%), homework (20%) and classroom activity (10%), and 10% for quizzes. In order to successfully pass the subject, a student must score 60% or more of the allotted points.*
Reading list	1. S.*A.Salikhov, A.Sh.Bakhronov "Patentology, Licensing and Certification" subject (study). T.: - TDIU, 2010. 272 pages.* *2. J.M.Qurbanov Patent studies, licensing and certification, textbook, 2018. 295 pages*

Module designation	**STS-5108 “Water-saving irrigation technologies”**
Semester(s) in which the module is taught	*2*
Person responsible for the module	*Matyakubov Bakhtiyar, DSc, Professor*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*"Higher mathematics", "Mathematical modeling", "irrigation improvement", "irrigation and improvement", "technologies of efficient use of water in agriculture".*

Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- knowledge of construction norms and rules and other regulatory documents in the selection and design of irrigation melioration, water-saving irrigation technologies;* *- know how to apply the theoretical and practical knowledge gained in the field in practice;* *- principles of organizing field experiments using water-saving irrigation technologies;* *- to know how to collect information on the design of water-saving irrigation technologies, scientific analysis of data;* *- to be familiar with international standards during the design process; to know construction standards and regulations and to be familiar with foreign experiences;* *- the ability to use software to determine the rate, duration and timing of irrigation according to water-saving irrigation technologies;* *- the ability to find technical and economic options in the design of water-saving irrigation technology;* *- to know how to prepare recommendations and conclusions on the practical application of water efficient use technologies.* **Be able to:** *- selection of water-saving irrigation technology, irrigation method and technology, elements of irrigation technique;* *- design, construction and development of water-saving irrigation technologies and perform hydraulic calculations;* *- scientific substantiation of determining crop irrigation procedures in the application of water-saving irrigation technologies;* *- scientific justification of technical and economic calculations of the use of water-saving irrigation technologies;* *- to be able to process the experimental results obtained in field conditions using mathematical statistics.* **form competences in:** *- formation of qualified personnel working in the field of water management in the future;* *- forming a methodological approach to the field and a scientific outlook;* *- choosing and justifying the use of water-saving irrigation technologies;* *- expansion of planning depending on the type of crop in the selection and justification of water-saving irrigation technologies;* *-scientific justification of determining optimal crop irrigation periods and irrigation rate;* *- finding technical and economic options for deploying water-saving irrigation technologies;* *- planning and conducting independent scientific research;* *- economic calculation on the use of water-saving irrigation technologies* *- should have the ability to make decisions on the implementation of books, selection and recommendations.*

Content: The discipline includes the following topics. The level of difficulty: (1 – low, 5 high):	*Soil specific gravity, relative resistance, viscosity, etc. Mechanical and physical properties of the soil are indicators that determine soil fertility. Bulk density, porosity, water permeability, water holding capacity. Soils with light, medium and heavy sandy loam and clay mechanical composition. Water permeability. Level of difficulty: 3.* *Water in the soil. Soil water properties: moisture content. Soil moisture capacities: Total soil moisture capacity (TNS). Capillary moisture capacity of the soil (KNS). Boundary moisture capacity of the soil (ChDNS). Maximum molecular moisture capacity of soil (MMNS). Total moisture capacity of the soil, capillary moisture capacity. Limit field moisture capacity of the soil, maximum - molecular moisture capacity. Gravity water. Level of difficulty: 3.* *Soil permeability, water carrying capacity, etc. Forms of water in the soil and their importance for plants. Soil moisture capacities and their importance in irrigated agriculture. Properties of water supply, transmission and lifting of the soil. Level of difficulty: 3.* *Amounts of humus in the soil. Humus is the composition of the organic part of the soil. The dependence of soil moisture on the amount of humus. Amounts of humus in the soil. Methods of determining the amount of sweetness. Humus is the composition of the organic part of the soil. The dependence of soil moisture on the amount of humus. Ways to increase the amount of humus in irrigated fields. Level of difficulty: 3.* *Agrochemical and agrophysical indicators of soil. Agrochemical and agrophysical properties of soil. The principle of soil moisture conservation. Types of local fertilizers. The basis of local fertilizers. Factors of manure storage and quality improvement. A method of eliminating salinity in irrigated areas. Preparation of manure-soil compost. Compost storage. Compost and principles of its preparation. Biohumus is an effective tool. Terms of use of fertilizers. Level of difficulty: 3.* *The order of crop irrigation, water balance, total water consumption. Irrigation method of crops. Methods of determining the order of irrigation of agricultural crops. Factors affecting irrigation of agricultural crops. Water consumption of crops. Total water balance. Formulas for determining total water consumption. Balance of water balance. Level of difficulty: 4.* *Determination of crop irrigation and seasonal irrigation standards. Brief description for hydromodule zoning. Irrigation method of crops. Soil moisture capacity. Total water consumption. Seasonal and irrigation standards. Irrigation hydromodule. Hydromodule zoning of irrigation areas. Conditions that ensure the normal development of agricultural crops. Water consumption of agricultural crops. Seasonal watering and watering rates. Hydromodule types. Ordinate graphs. Irrigation mode of rice. Hydromodule zoning of irrigated lands. Law of absorption of water into the soil. Level of difficulty: 4.* *Irrigation methods and irrigation techniques. Irrigation methods and techniques. Requirements for irrigation methods and techniques. Overland irrigation technique and its improvement. Level of difficulty: 5.*

	Irrigation over the ground, sprinkler, drip, underground and finely dispersed (mist). Above ground irrigation equipment. Sprinkler, subsoil and subirrigation irrigation methods. Drip and spray irrigation techniques. Drip irrigation design. Irrigation methods, types of irrigation techniques, requirements for them and their selection. Elements of surface irrigation technique. Watering rice. Overground irrigation equipment. Drip irrigation of orchards, grapes and rice crops, watering with the help of cotton soft portable irrigation pipes and film laid on egates. Leveling of irrigation fields. Level of difficulty: 3. *Application conditions, advantages and disadvantages of irrigation methods. Irrigation methods. The essence, techniques, conditions of use of raining, spraying, drip, subirrigation (raising the level of seepage waters) and irrigation from the soil. Functions of irrigation methods. Advantages and disadvantages of irrigation methods. Level of difficulty: 3.* *Water use plan. Principles of planned water use. Information needed for drawing up a water use plan. Basic principles of planned water use. Theoretical basis of development of water use plan. Level of difficulty: 4.* *Structure of water use plan. Limited use of water. Structure of water use plan. Drawing up a water use plan. The procedure for calculating the water use plan. Water limit. The main indicators of the water use plan (SFR). Water distribution chart. The basis of planned use of water. Level of difficulty: 4.* *Operational hydrometry and water accounting in hydromelioration systems. The simplest water measuring devices in small canals and ditches. Vodoslivs. Installation of water pipes. Measurement of water consumption passing through Vodosliv. An unchanging soul. Level of difficulty: 4.* *Principles of choosing water measuring stations and their construction sites. Measurements of water consumption in inter-farm and intra-farm canals, their theory and practice. Thomson and Chipoletti water meters, conditions of their use. Organization of water measurement in parabolic troughs. The scheme of choosing a place for a hydroelectric plant. Level of difficulty: 3.* *Constructions of water measuring devices and structures. Hydrometric ruler and its application. Water measuring devices. Constructions of water measuring devices and structures. Hydrometric ruler and its application. An improved hydrometric tube. Water measuring tools and their selection. Basic morphometric characteristics of the flow. Conditions for determining the distance between the speed verticals. Determination of observation points depending on the depth of the velocity verticals. Level of difficulty: 4.* *Hydraulic calculation of drip irrigation system. Hydraulic calculation in drip irrigation. Hydraulic calculation methods. Principles of pressure detection in the pipeline. Calculation of pressure in the system. Calculation of indicators in the irrigation system. Level of difficulty: 5.* *Drip irrigation system drippers, type of dripper. Droppers of the drip irrigation system. Technical justification of the choice of the type of dropper. Level of difficulty: 5.*

	Dropper tapes and their selection. The structure of drip tapes. Calculations to be performed when choosing dropper tapes. Structure of tape. Economic justification of tape selection. Level of difficulty: 5. *Technological basics of dropper tapes. Organization of irrigation in drip tapes. Micro-currents. Technological basics of drip tapes. The role of the drip tape in organizing drip irrigation. Micro-currents and their management. Level of difficulty: 5.* *Method of sprinkler irrigation, conditions of use. Advantages and disadvantages. The method, goals and tasks of sprinkler irrigation. Terms of use. Advantages and disadvantages. Level of difficulty: 4.* *Sprinkler irrigation technology. Improvement of sprinkler irrigation system. Sprinkler irrigation technology. Improvement of the irrigation system. Technical measures. Level of difficulty: 4.* *Sprinkler irrigation, technical elements: rain speed, rain drop diameter. Sprinkler irrigation technique. Elements of irrigation technology. Principles of detection. Rain intensity. Raindrop diameter. Level of difficulty: 5.* *Impulse sprinkler irrigation technology. Movement of water in pipes in closed irrigation networks. Pressurized and non-pressurized system. Pressure closed irrigation networks. Closed irrigation networks without pressure. Dependence of water movement on slope. Level of difficulty: 5.* *Subirrigation, application conditions, advantages and disadvantages, scientific justification. The method of irrigation from under the soil (subirrigation). Terms of use. Subirrigation irrigation method, theoretical basis, advantages and disadvantages. Scientific justification of the subirrigation method. Level of difficulty: 3.* *Discrete irrigation technology. Selection principles. Terms of use. Discrete irrigation method. Irrigation technology. Principles of irrigation method selection. Terms of use. Theoretical foundations. Problems observed in the application of the discrete irrigation method and recommendations for their elimination. Level of difficulty: 4.* *Advantages and disadvantages of using discrete irrigation technology. Automated watering cans. Advantages and disadvantages of using discrete irrigation technology. Use of discrete irrigation technology in providing water to crops. The principles of using automated rods for irrigation. Level of difficulty: 4.* *Pulsar irrigation method, technology. Selection principles. Terms of use. Advantages and disadvantages. Pulsar irrigation method. Irrigation technology. Principles of irrigation method selection. Terms of use. Advantages and disadvantages. Level of difficulty: 3.* *Spray irrigation method, technology. Selection principles. Terms of use. Advantages and disadvantages. Spray irrigation method, goals and tasks. Irrigation technology. Selection principles and conditions of application. Advantages and disadvantages. Improvement of the irrigation method. Level of difficulty: 4.*

	Principles of using water-saving irrigation technology in the Republic and in foreign countries. Principles of using water-saving irrigation technology in the Republic of Kazakhstan and in foreign countries. Observed problems and suggestions and recommendations for their elimination. Level of difficulty: 5. *The results of the application of water-saving irrigation technology. Importance of water-saving irrigation technology in production. The results of the application of water-saving irrigation technology. The role and importance of water-saving irrigation technology in production. Level of difficulty: 5.*

	Irrigation procedure of farm crops, irrigation hydromodule and its graph. Level of difficulty: 3. *Elements of irrigation technique of irrigation methods. Accepting the elements of irrigation technology. Level of difficulty: 2.* *Methods of designing drip irrigation in field conditions. Determining estimated water consumption. Implementation of hydraulic calculation. Level of difficulty: 5.* *Methods of designing sprinkler irrigation in field conditions. Sprinkler machines and mechanisms. Determining estimated water consumption. Implementation of hydraulic calculation. Level of difficulty: 5.* *Methods of designing sprinkler irrigation in field conditions. Sprinkler machines and mechanisms. Level of difficulty: 3.* *Subirrigation irrigation method. Application, positive and negative principles. Calculation of water standards for crop irrigation by subirrigation method. The main indicators for using the subirrigation method. Areas of application of subirrigation method and crops. Level of difficulty: 5.* *Management of water resources. Associations of water consumers. Level of difficulty: 3.* *The method of watering from inside the soil. Application, positive and negative principles. Calculation of irrigation and seasonal irrigation rate for in-soil irrigation. Dispersion curve formation. The main indicators when using the irrigation method. Level of difficulty: 5* *The method of watering by creating fog. Application, positive and negative principles. Irrigation rate calculation. Dispersion curve formation. The main indicators when using the irrigation method. Level of difficulty: 4.* *The main requirements for fields in the design of water-saving irrigation technologies. Basic information on water-saving irrigation technologies. Level of difficulty: 4.* *Using the device for preparing fertilizer solution and adding it to water. Level of difficulty: 3.* *Analysis of research on water-saving technologies. Analysis of rainfed and subirrigation research. Level of difficulty: 5.* *Irrigation by laying a film on the ground, watering the ground by cutting and spreading the ground, using portable flexible pipes and their calculation. Level of difficulty: 4.* *Deployment of water-saving irrigation technologies in the field. Calculation and field placement and application of sprinkler irrigation method. Level of difficulty: 5.* *Recommendations and proposals for the use of water-saving technologies, positive principles of implementing water-saving technologies. Level of difficulty: 5.*
Exams and assessment formats	*Since there are two semesters, there are four midterms (30 minutes each) and a final oral exam (60 minutes), computerized or written.*
Study and examination requirements	*Students who successfully pass the subject (in both semesters):* *The total maximum score will be the sum of the points allocated to the final exam (60%), the Midterm (20%) and the classroom activity (20%). In order to successfully pass the subject, a student must score 60% or more of the allotted points.*

Reading list	*1. Mamatov S.A., Khamrayev Sh.R., Karshiyev R.J., Zaks I.A., Burkhonjonov B.Sh. "Fundamentals of water-saving irrigation technologies". Tashkent-2022, Info Capital Books. 382 p. (uzbek).* *2. José Manuel Gonçalves, Qingfeng Miao, Isabel Maria Duarte, Haibin Shi. "Water-Saving Techniques and Practices for On-Farm Surface Irrigation Systems", May 2021, Biol. Life Sci. Forum 2021, 3(1), 46; https://doi.org/10.3390/IECAG2021-09675* *3. David Molden. "Water for Food Water for Life: A Comprehensive Assessment of Water Management in Agriculture" // 23 July 2013* *4. Mamatov S.A. "Drip irrigation system". Manual. T. "Mehridarya", 2012, 80 pages. (uzbek).*

Module designation	**LI5104-Landscape irrigation**
Semester(s) in which the module is taught	*2*
Person responsible for the module	*Begmatov Ilkhom Abduraimovich, candidate of technical sciences, professor*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*"Irrigation amelioration", "Water resources measurement and tools".*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- to have an idea about landscape irrigation;* *- construction standards and regulations and other regulatory documents, irrigation procedures, irrigation technologies and methods in designing water-saving irrigation technologies;* **Be able to:** *- know and be able to use elements of irrigation technology;* *- design of hydraulic calculations and cuttings, irrigation erosion and complex measures against it;* **form competences in:** *- the composition and characteristics of the natural landscape, the selection of elements of landscape irrigation;* *- methods and techniques, and the ability to find technical and economic options for placing irrigation networks.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Content of the subject: Introduction to the subject of "Landscape irrigation". Concept and basic principles of landscape science. The composition and nature of the natural landscape. Geochemistry of landscapes. Anthropogenic landscapes. Irrigation melioration. Level of difficult: 1.* *Techniques and technology of irrigation of agricultural crops. The method of irrigation over the soil. The technology of dividing the Egat water along the length of the Egat. Discrete irrigation technology. Automated watering cans. Leveling of irrigation fields. Sprinkler irrigation technology. Level of difficult: 2.* *Impulse sprinkler irrigation technology. Irrigation technology from inside the soil. Drip irrigation technology. The technology of drip irrigation from the soil. Underground irrigation technology. Sprinkler irrigation technology. Water sources for irrigation. Use of surface water for irrigation. Formation of collector water and its use for irrigation purposes. Level of difficult: 3.*
Exams and assessment formats	*There are two midterms (20 minutes each) and a final oral exam (40 minutes), a short computerized test and written homework.*
Study and examination requirements	*The total maximum points awarded will be the sum of the points allocated to the final exam (60%), Midterm (20%), homework (10%) and classroom activity (10%). In order to successfully pass the subject, the student must score 60% or more of the allotted points.*
Reading list	*1. Begmatov I.A. "Landscape Irrigation" Manual. -Tashkent: TIMI, 2019. - 251 str.* *2. Khamidov M.Kh., Begmatov I.A., Isaev S.Kh., Mamatov S.A. "Water-saving irrigation technologies" Training manual. T., TIMI printing house, 2015. 243 pages*

Module designation	**Biomelioration**
Semester(s) in which the module is taught	*2*
Person responsible for the module	*Isaev Sabirjan, doctor of agricultural science*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*«Methods of scientific research in land reclamation», «Water conservation technologies in irrigated lands», «Soil-plant-water relationship», «Land reclamation and land reclamation», «Measurement and tools of water resources», «Landscape irrigation».*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- soils and their properties;* *- to determine the agrophysical-agrochemical properties of the soil;* *- determination of saline soils, primary and secondary salinity;* *- phytomelioration, halophytic plants;* *- forest reclamation.* **Be able to:** *- factors to eliminate salinity;* *- use of biosanvet preparation in saline washing;* *- the role of repeated crops after winter wheat in increasing soil fertility;* *- structure and calculation of collector systems.* **form competences in:** *- organization of scientific research on phytomelioration;* *- organization of efficient use of collector ditch water;* *- reducing the migration of collector ditch waters with the help of microphytes;* *- biological and reclamation plants;* *- organization of scientific research on biological drainage.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*The main soils of Uzbekistan and their characteristics. Biological drainage. Biomeliorant plants and their classification. Level of difficulty: 2* *Halophytic plants, their types and characteristics. Phytovit plants and soil fertility restoration with their help. Phytomelioration. Level of difficulty: 3* *Use of biological compounds in irrigation and saline washing. Biological technologies in wastewater treatment. Level of difficulty: 4* *Biological reclamation of water bodies. Soil strengthening plants. Methods of biomelioration of dry lands. Forest melioration. Level of difficulty: 5*
Exams and assessment formats	*One written midterm assessments (30 minutes), take-home written assignments and one final oral exam (40 minutes).*
Study and examination requirements	*Requirements for successfully passing the module:* *The final grade in the module is composed of 40% performance on exams, 20 % independent work, 20 % practical work, 20 % mid-term control tests. Students must have a final grade of 60% or higher to pass*
Reading list	*1. Kasimbetova S.A., Akhmedjanova G.T., Ergashova D.T.- Biomelioration. Methodical guide. Tashkent 2019, page 135.* *2. Isaev S.Kh. etc. Pasture reclamation, Training manual. Tashkent, TIMI. 2020-186 pages.* *3. Recommendations on accelerating food production in cultural pastures in Uzbekistan, Tashkent, 2015, p. 23.* *4. Norkulov U., Allanov Kh. "Lecture materials on the science of pasture land reclamation" T. 2011. 142 pages.*

Module designation	**Economics of using nature**
Semester(s) in which the module is taught	*1*
Person responsible for the module	*Sattorov Orif Boymurodovich, PhD, associated prof.*
Language	*Uzbek, Russian.*
Relation to curriculum	*selection*
Teaching methods	*lecture, seminar*
Workload (incl. contact hours, self-study hours)	*Total workload:120* *Lecture:30* *Seminar:30* *Self-study:60*
Credit points	*4*
Required and recommended prerequisites for joining the module	*«Economic theory», «Water resources management and melioration», «Hydrology».*

Module objectives/intended learning outcomes	After mastering the discipline, the student will: ***To know and understand:*** *- within the framework of the discipline, the student must master the fundamental provisions and categories of modern economic theory in relation to the patterns of functioning of a market economy, the mechanisms of price formation, production volumes, the behaviour of the main economic entities in various types of markets, the fundamentals of consumer behaviour and the production process, the relationship and dynamics of the volume of national production, inflation, employment, the fundamentals of the world economy, features of the functioning of the economy of Uzbekistan in the conditions of modernization and structural adjustment;* *- basic philosophical concepts and categories, patterns of economic development of society;* *- basic concepts and models of microeconomic theory, macroeconomics and world economy;* ***To be able to:*** *- the student will master economic thinking skills.* *- the student acquires practical skills in studying economic processes.* *- the student will expand his knowledge in the field of economic theory and form a scientific socio-economic worldview.* *- the student develops the ability to assess the effectiveness and socio-economic consequences of specific government measures used in the implementation of state economic policy.* *- the student will gain an understanding of the application of methods for analyzing the processes of economic development of the national economy and the economy of industrialized countries.* *- the student independently makes economic decisions on economic problems.* ***To form competences in:*** *- basic methods of quantitative analysis and modeling, theoretical and experimental research;* *-culture of thinking, ability to perceive, generalize and analyze information, setting a goal and choosing ways to achieve it;* *- analytical skills in the field of applied aspects of economic theories;* *- carry out professional communication and communication on issues of organization and managing one's own professional activities;* *- the student must have the skills to think economically, conduct research on economic phenomena, identify patterns, establish correlations between individual phenomena, justify their point of view, check the reliability of research findings, and make decisions.* *- apply the conceptual and categorical apparatus, basic economic laws in professional activities;* *must have the skills of a holistic approach to the analysis of economic phenomena; use the acquired knowledge to express your own assessment of economic phenomena and processes.*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Basic issues of economics and ways to Economic theory as a science. Subject and methods of research Subject and methods of economic science. Principles of Economics. Positive and normative analysis. Rational behavior. Free and economic benefits. Factors of production. Income of owners of production factors. Limited (scarce) factors of production and limitless needs: the problem of choice. Society's production possibilities frontier. Opportunity costs. Comparative advantage. Division of labor, specialization and exchangesolve them in various economic systems. Level of difficulty: 3.* *Market, its structure and functions. Institutional foundations of a market economy. The essence of the market, its functions. Market structure. Market mechanism. Demand, supply, price. Explanations for changes in quantity demanded as a result of changes in price. Non-price determinants of demand. Normal and inferior goods. Interchangeable and complementary goods. Individual and market demand. Constructing a market demand curve. A change in the quantity supplied as a result of a change in price. Non-price determinants of supply. Shifts in the supply curve when non-price determinants change. Construction of the market supply curve. The concept of elasticity. Price elasticity of demand and its factors. Elastic and inelastic demand and revenue of sellers. Income elasticity of demand. Cross elasticity. Price elasticity of supply. Partial equilibrium in a perfectly competitive market in the short run. The effect of changes in supply and demand on equilibrium price and equilibrium quantity. The concept of general equilibrium. Level of difficulty: 4.* *Marginal utility theory and consumer behavior. Consumer preferences. Rational consumer choice. Preference relations among consumption bundles. Examples of preferences: complements, substitutes, indifferent goods, anti-goods. Utility in economic theory and problems of its measurement. Total and marginal utility. Utility function. Law of diminishing marginal utility of a good. Consumer equilibrium from cardinalist positions. Consumer choice from an ordinalist position. Level of difficulty: 5.*
Exams and assessment formats	*Educational results are evaluated in a 100-point rating system. One midterm (60 points) and final oral exam (40 points)*
Study and examination requirements	*Requirements for successfully passing the module* *To pass the subject successfully, the student must score 60% or more of the allotted points.*
Reading list	*1. David L. Debertin. A. Agricultural Production Economics. Second Edition, Amazon Createspace 2012. 242 p.* *2. Umurzoqov O'.P.,Sultonov A.S. Rashidov J.X. Water economy and management. Textbook. TIIAME. 2016 y.* *3. U. Sangirova, Kh. Yakubova, U. Kholiyorov, G. Kholmurodova "Economics and Management" Textbook TIIAME – 2021 г.* *4. Sangirova U.R., Sattorov O.B., Economics and management of water management. Textbook. "TIIAME" MTU. 2022*

Module designation	**Automation of watering**
Semester(s) in which the module is taught	*3*
Person responsible for the module	*PhD Amanov Boxodir To'xtasinovich*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*Hydraulics. Hydro automatics. Use of pumps and pumping stations*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: ***To know and understand:*** - *It consists of a set of methods and tools that allow masters to automate the distribution of water in canals and manage water distribution without direct human intervention, or to facilitate the work of operational staff in distributing water between consumers,* - *knowledge bases in the automation of hydromelioration systems, improvement of the state of improvement of the existing hydromelioration network, mechanization and automation of water distribution processes, mechanization of work in production processes, having a vision of systematically increasing the yield of sustainable agricultural crops from meliorated areas by implementing complex water management activities.* ***To be able to:*** - *to know the basics of various automatic devices used in the field of water management and land reclamation, their types,* - *scope of use, basis of calculation and their selection in accordance with specific conditions, as well as the methods of developing measures to improve the conditions based on the received information and be able to use them.* ***To form competences in:*** - *In the automation of hydromelioration systems, it is necessary to have the skills to apply the methods of analysis of technical events and processes, to accept solutions to technical problems,* - *in the design of water-saving innovative techniques and technologies, the rules of construction standards and other normative documents,* - *the selection of modern innovative techniques and technologies, methods and elements of water-saving irrigation,* *finding technical and economic convenient options for placing irrigation networks.*
Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Components of hydromelioration systems. Purpose and objectives of water use planning in irrigated agriculture. Level of difficult: 2.* *Use and automation of irrigation networks. Level of difficult: 2.* *Cluster, automation of crop irrigation on the farm, use and automation of irrigation networks. Level of difficult: 3.* *Plans for development and reconstruction in the use and automation of irrigation networks. Production and scientific research works on the use and automation of irrigation networks Level of difficult: 5.*
Exams and assessment formats	*One midterm control (30 minutes each) and final oral exam (40 minutes), a*

	short computerized test and written homework are provided.
Study and examination requirements	*Фандан муваффақиятли ўтиш талабалари* *Жами йиғиладиган максимал баллар якуний имтихонга (60%), Оралик назоратга (20%), уй вазифасига (10%) ва аудиториядаги машғулотларда фаолликка (10%) ажратиладиган баллар йиғиндисидан иборат бўлади. Фандан муваффақиятли ўтиш учун талаба ажратилган балларинг 60% ва унда юқори миқдорини тўплаши керак.*
Reading list	*1. Brian Wahlin, Darell Zimbelman, "Canal Automation for Irrigation Systems" ASCE Publications. USA 2014.* *2. Serikbayev B, Dostnazarova S. "Irrigation automation" Methodological manual. Tashkent TIIAMEI, 2020. – 82 p;* *3. Serikbayev B.S., Sherov A.G., Ibragimova H.R. "Modernization of hydromelioration systems", Textbook. Tashkent. "TIIAME" 2018y.-467 b;* *4. Baraev F.A., Serikbaev B.S. i second. Operation and automation of the hydromelioration system. Textbook. Tashkent. "TIIM", 2013. - 270 p.* *5. Automating the flow. Methodical instructions for conducting practical training in science. Tashkent-2019.*

Module designation	**Reclamation of pastures**
Semester(s) in which the module is taught	*3*
Person responsible for the module	*Isaev Sabirjan, doctor of agricultural science, professor* *Kasimbetova Saltanat, associate professor*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*«Agriculture and Soil Science», «Introduction to Water Reclamation», «Irrigation and Reclamation», «Chemical Reclamation», «Improvement of Natural Conditions».*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- use of pasture lands in agriculture* *- relationship with pasture lands in agriculture* *- preservation of grassland ecosystems* *- pasture infrastructures* *- sources of water supply* **Be able to:** *- use of pasture lands in agriculture* *- melioration of pastures* *- water supply systems* *- ecological requirements for the use of pastures* *- elimination of pasture degradation* **form competences in:** *- the ability to increase the efficiency of pastures* *- cultivation of drought-resistant crops in pastures* *- restoration and preservation of pasture plants* *- increase the productivity of pastures* *- restoration of pastures*

Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Relationships with the use of pasture land in agriculture. Conservation of grassland ecosystems. Level of difficulty: 2* *Boreholes and their construction. Features of irrigation networks in pastures. Level of difficulty: 2* *Reclamation of pastures: establishment of local water supply systems. Sources of water supply. Groundwater. Local stream waters. Ports. Level of difficulty: 3* *Meadow plants. Restoration and preservation of pasture plants. Increase the productivity of pastures based on the organization of phytomelioration and pasture rotation. Level of difficulty: 4* *Management of pasture use. Use of pastures and restoration of its productivity. Improving pasture efficiency and eliminating pasture degradation. Level of difficulty: 5*
Exams and assessment formats	*There are two midterm exams (20 minutes each) and a final oral exam (40 minutes), a short computerized test and written homework.*
Study and examination requirements	*The total maximum points awarded will be the sum of the points allocated to the final exam (60%), Midterm (20%), homework (10%) and classroom activity (10%). In order to successfully pass the subject, the student must score 60% or more of the allotted points.*
Reading list	*1. Kasimbetova S.A., Akhmedjanova G.T., Ergashova D.T.- Biomelioration. Methodical guide. Tashkent 2019, page 135.* *2. Isaev S.Kh. etc. Pasture reclamation, Training manual. Tashkent, TIMI. 2020-186 pages.* *3. Recommendations on accelerating food production in cultural pastures in Uzbekistan, Tashkent, 2015, p. 23.* *4. Norkulov U., Allanov Kh. "Lecture materials on the science of pasture land reclamation" T. 2011. 142 pages.*

Module designation	**In irrigation and reclamation computer modeling**
Semester(s) in which the module is taught	*3*
Person responsible for the module	*Ishchanov Zhavlon, associate professor*
Language	*Uzbek, Russian*
Relation to curriculum	*Elective*
Teaching methods	*Lecture, practical lesson*
Workload (incl. contact hours, self-study hours)	*Total workload: 120 hours.* *Contact hours: 60 hours:* - *lecture – 30 hours;* - *practical lessons – 30 hours;* - *self-learning - 60 hours.*
Credit points	*4*
Required and recommended prerequisites for joining the module	*"Scientific Research Methodology", "Reclamation Soil Science", "Hydromelioration Systems Research", "Geoinformation Systems in Irrigation and Reclamation".*
Module objectives/intended learning outcomes	After mastering the discipline, the student will: **know and understand:** *- to have an idea of the work to be done in the implementation of the system of recultivation of lands damaged by anthropogenic and natural influences, improvement of land reclamation conditions of different categories.* **Be able to:** *- knowledge of water management activities in land reclamation and recultivation, water resources and soil protection, soil fertility preservation and restoration methods.* **form competences in:** *- types of reclamation and recultivation, their design, construction and use, repair-restoration and reconstruction, should have the skills to carry out scientific research in the field of reclamation and recultivation.*
Content: The discipline includes. The *level of difficulty*: (1 – low, 5 high):	*Modeling and its role in the field of "Irrigation and reclamation". Soil-water-atmosphere-vegetation (SWAP) model. Modeling soil salinity based on remote sensing data. Modeling of soil salinity based on the SALTMOD program. Level of difficulty: 1.* *Drip irrigation system design using DIDAS software. Irrigation scheduling based on NaanDanJain (NaanCAT) irrigation system software. Design and evaluation of overland irrigation through the SURDEV program. IRRICAD Irrigation Planning Software. Level of difficulty: 2.* *Determining the water demand of agricultural crops through the CropWat program. FAO AquaCrop Model: predicting water use efficiency and agricultural crop yields. Modeling of evapotranspiration of agricultural crops based on the SEBAL model. Level of difficulty: 2.* *Calculation of evapotranspiration using the ETo calculator program. SPAW (Soil-Plant-Air-Water) model for arid zones. Groundwater modeling based on visual MODFLOW software. Level of difficulty: 3.*
Exams and assessment formats	*One written midterm assessments (30 minutes), take-home written assignments and one final oral exam (40 minutes).*

Study and examination requirements	*Requirements for successfully passing the module:* *The final grade in the module is composed of 40% performance on exams, 20 % independent work, 20 % practical work, 20 % mid-term control tests. Students must have a final grade of 60% or higher to pass*
Reading list	*1. Khamidov M., Botirov Sh., Hamidov A. "Melioration and land recultivation" Textbook. T.: 2021, 299 p.* *2. Khamidov M., Isabaev K. Hamidov A. "Land reclamation and land reclamation" Instructional manual. T.: 2022, 256 p* *3. Golovanov, A.I. Reclamation narushennix zemel [Electronic resource], Moscow, 2008.* *4. Stekolnikov K.E., Gasanova E.S. "Melioration and recultivation of land". Uchebnoe posobie. Voronezh, 2015.* *5. S.A. Kasimbetova, A.I. Dolidudko, G.T. Akhmedjanova, Land recultivation and protection. Methodological instruction. Tashkent. 2014.*