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**Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA (RUDN University)
named after Patrice Lumumba**

COURSES' DESCRIPTION

The mastering of the course is carried out as part of the implementation of the main professional syllabus (Higher Education programme, specialization)

«Integrated Solid Waste Management» (Network program with L.N. Gumilyov Eurasian National University)

(Profile/Specialization of Higher Education Professional Program)

implemented in the Higher Education Field:

05.04.06 Ecology and Nature Management
(Code and Name of Higher Education Field)

2023 г.

Disciplines (modules) are studied as part of the mastering of Higher Education Program «Integrated Solid Waste Management » (Joint Program with the Eurasian National University named after L.N. Gumilyov)» in frame of Higher Education Field 05.04.06 Ecology and Nature Management

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| Course title | <i>IT in ecology and natural resources management</i> |
| Course Workload , credit units /academic hours | 4 /144 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| Actual problems of ecology and nature and the mission of computer technology analysis and processing of information | Computational methods of environmental impact assessment, risk assessment etc. The use of computer tools (Excel) for economic and environmental settlements. Specialized programs for complex calculations to assess the impact on the environment and risk analysis. The software graphics processing means. Software GIS tools. |
| Primary processing of statistical data with Excel | Characteristics of distribution, their interpretation and the ways of their calculation on the sample. Compilation series interval and calculation of their characteristics. Histogram and polygon feature of frequency allocations. |
| Testing statistical hypotheses | <p>Statistical hypothesis and their application to real-world problems.</p> <p>Parametric tests and conditions of use. Testing the hypothesis of distribution law.</p> <p>Comparison of the average value and of the variances of two samples using parametric tests.</p> <p>Nonparametric tests. Calculation agreed ranks.</p> <p>Comparison of the average value and of the variances of two samples using nonparametric tests.</p> <p>Comparison of the average by more than two samples. Variance analysis. Nonparametric variance analysis.</p> <p>Assessment of data consistency.</p> <p>Errors of observation and confidence intervals characteristics of large and small samples.</p> <p>Determining the necessary sample size.</p> |
| Correlation and regression analysis | <p>Statistical connection and methods of research.</p> <p>Correlation coefficient: graphical evaluation, Pearson's coefficient, Spearman's coefficient? Kendall's coefficient.</p> <p>Linear regression analysis. Simple linear regression.</p> <p>Multiple linear regression.</p> <p>Nonlinear regression models, correlation ratio.</p> |
| Analysis of time series | <p>Time series, classification, structure, tasks and conditions of the study.</p> <p>Characteristic's analysis of the time series.</p> <p>Analysis of the dynamic series trend. Forecasting.</p> |

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| | Identification of seasonal fluctuations in the dynamic series. |
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| Course title | <i>International cooperation in the field of nature protection</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| Introduction. The concept of international cooperation in the field of environmental protection, the main stages of its formatio | The subject, objects, principles and sources of international legal regulation of environmental quality. |
| Modern global environmental problems and the implementation of the principles of sustainable environmental and economic development. | Sustainable Development Goals. Criteria for sustainable development. The concept of a circular economy. International experience in jointly solving global international organizations and their role in environmental protection of environmental problems |
| International conferences as a tool for solving international environmental problems. | The role of the international treaty and its features in the regulation of interstate relations in the field of environmental protection. International agreements. Contribution of international conferences to the development of international environmental law (retrospective analysis). Basic international legal documents. The content of the most important regional agreements. |
| Legal mechanisms of international legal regulation | General concepts of international environmental law. International legal regulation of the protection of the marine environment; protection of atmospheric air, near-Earth outer space and climate. International legal protection of biological diversity in general, flora and fauna. State Responsibility for Environmental Pollution |

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| Course title | <i>Methodology of Scientific Creation</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |
| Course Modules | Содержание раздела (тем) дисциплины: |
| Research methods, their development in ecology. | Key terms and definitions, structure of research activities, relevance and scientific novelty, classification of research methods, problem identification tools, methods aimed at enhancing the use of experience and intuition of specialists, logical laws. |
| Introduction to Information Search Theory | Information, types of information, upward / downward flows of information, the birth of information, the law of dispersion of information. |

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| | Information search, information search on the Internet, use of libraries and databases. |
| Empirical methods of cognition | Methods of empirical knowledge, observation, measurement, measurement scales, measurement errors, concept of an experiment, design of an experiment, processing of experimental results, surveys, interviews, expert surveys, etc. |
| Methods and approaches to the analysis of data | Statistical and mathematical methods in ecology. The reliability and validity of the data. Experiment, approaches to analysis. Collection and analysis of databases. |
| Presentation of scientific data | General requirements for research, the basics of scientific citation, the effectiveness of scientific research, the concept of plagiarism in scientific activity, discoveries, their mechanism and typology. |
| Graduation works (thesis) | Thesis planning. Responsibilities of the head of the WRC. The structure and design of the WRC. WRC data presentation approaches. Presentation of work. |
| Research Article | Types of scientific articles. Types and ratings of magazines. Citation index. Article Writing Approaches |
| Conferences, symposia, etc. | Types of scientific events. Purpose of participation in conferences, etc. Presentation of materials. Scientific discussion and its importance in promoting research, conducting scientific discussion. |
| Research financial support | Grants. Funds. Paid scientific activities under contracts. Grant application, design and planning. |
| Ethical aspects of scientific research in ecology | Code of Ethics. |

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| Course title | <i>Nature Protection and Accumulated Environmental Damage (AED) Elimination Tools</i> |
| Course Workload, credit units /academic hours | 4/144 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| 1. Classification of technological solutions for the rehabilitation of objects of accumulated harm. | Technological solutions used for the rehabilitation of contaminated areas. Chemical oxidation-reduction method. Electrical rehabilitation. Biorehabilitation intensified by redox additives. Soil flushing. Controlled natural self-cleaning. Installation of permeable reaction barriers. Phytorehabilitation. Bubbling. Curing / stabilization. Heat treatment. Purge. Vitrification (vitrification). Engineering methods. |

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| <p>2. Reclamation and land improvement work.</p> | <p>General issues of the organization of work on the restoration and arrangement of disturbed lands. Classification of disturbed lands by technogenic relief and area. Types of natural and technogenic landscapes. Stages and stages of reclamation of natural and technogenic landscapes. Classification of overburden. Reclamation and arrangement of dumps and embankments. Production methods and characteristic features of disturbed lands during peat mining. Biological reclamation of developed peat deposits. Processes when performing work at the biological stage of reclamation. Reclamation and arrangement of disturbed lands by landfills and landfills of MSW. Reclamation and arrangement of flooded quarries. The formation of vegetation on dumps and artificial ponds. Reclamation of land disturbed by underground mining. Reclamation of hydraulic dumps. Requirements for land reclamation violated during the construction and operation of linear structures. Reclamation and arrangement of quarries of non-metallic materials during dry excavation. Reclamation of stone quarries. Classification of anti-erosion hydraulic structures.</p> |
| <p>3. Examples of the production of secondary products in waste processing (not biotechnological)</p> | <p>Recycling of rubber products. Recycling plastic waste. Mining waste processing. Agloporite production. Processing and use of associated rocks. Overburden as a raw material for the production of expanded clay. Layout of worked out spaces. Geotechnology Getting hydrochloric acid and chlorine in the processing of organochlorine waste. The production of sulfuric acid in the processing of acid tars. Getting phosphoric acid in the processing of phosphorus sludge. Obtaining valuable products in the processing of metal-containing sludge.</p> |
| <p>4. Biotechnological processing of accumulated organic waste.</p> | <p>Biologically recyclable waste. Microbiological processing of organic waste. Technology of microbiological conversion of waste into feed protein. Composting. Anaerobic digestion and methane generation. Siloing. Physico-chemical and biological methods for the isolation of substances with the participation of the liquid phase. Leaching (extraction). Biosorption Chemistry of the bacterial oxidation of sulfide minerals. Leaching of heaps and dumps. In situ bacterial ore leaching</p> |

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| 5. Thermal processing of accumulated waste. | Gasification of waste. Types of gasification. Pyrolysis of waste. Oxidative pyrolysis. Dry distillation (dry pyrolysis). Types of dry pyrolysis. The fire method of processing waste. Classification of combustion methods. Devices of fire neutralization and waste processing. Examples of energy technology schemes for solid waste incineration. |
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| Course title | <i>History and Philosophy of Science</i> |
| Course Workload, credit units /academic hours | 2/72 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| General problems of the philosophy of science | Topic 1.1. Science in the culture of modern civilization. The emergence of science and the main stages of its historical evolution. The structure of scientific knowledge. The phenomenon of science. Basic forms of being of science. The structure of scientific activity. Science as a cognitive activity. Science as a special kind of worldview. Science as a specific type of knowledge. Science as a social institution. |
| | Topic 1.2. The dynamics of science as a process of generating new knowledge. Scientific traditions and scientific revolutions. Types of scientific rationality. Features of the modern stage of development of science. Prospects for scientific and technological progress. |
| The evolution of ideas in the philosophy of science | Topic 2.1. The emergence of science. The "beginning" problem. ancient science. medieval science. New European science. |
| | Topic 2.2. The image of science in the philosophy of F. Bacon. F. Bacon's empirical method. |
| | Topic 2.3. The emergence of the experimental method and its connection with the mathematical description of nature: G. Galilei. |
| | Topic 2.4. Structuring of scientific knowledge in the philosophical system of G. Hegel. |
| | Topic 2.5. R. Descartes' rationalistic method of cognition. |
| | Topic 2.6. The first stage in the development of positivism (O. Comte). The second stage in the |

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| | development of positivism is empirio-criticism (E. Mach, R. Avenarius). |
| | Topic 2.7. Popper: knowledge of the world, science and philosophy. The principle of verifiability and falsifiability. T. Kuhn's model of science development. |
| Philosophical problems of the environment | Topic 3.1. Philosophical and sociological substantiation of environmental education. Formation of ecological thinking in the process of education. |
| | Topic 3.2. The problem of demand regulation: ecological aspect. The current ecological situation as a reflection of the spiritual crisis. Man in the socio-ecological space of the city |
| | Topic 3.3. V.I. Vernadsky on the relationship between scientific and philosophical creativity. Theory of the noosphere. |

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| Course title | <i>Landscape and geochemical aspects of waste impact</i> |
| Course Workload, credit units /academic hours | 4/144 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| Geochemistry of landscapes | Topic 1.1. Landscape types and geochemical processes. Geochemical systematics of landscapes |
| | Topic 1.2. Clarks of chemical elements. Natural xenobiotic profile. Geochemical migration and geochemical barriers. |
| Geochemistry of technogenic landscapes | Topic 2.1. Human activity as a geochemical factor. Geochemical classification of technogenic processes. |
| | Topic 2.2. Technogenic leaching zones and geochemical barriers. Geochemical degradation and pollution of land by waste products. |
| | Topic 2.3. Deforestation, desertification and degradation of landscapes. Technogenesis in aquatic landscapes. |
| | Topic 2.4. Deforestation, desertification and degradation of landscapes. Technogenesis in aquatic landscapes. |
| | Topic 2.5. Landscape - geochemical analysis of territories. Soil classifications and natural and technogenic changes in soils. |
| Protection of geochemical landscapes | Topic 3.1. The role of organisms in soil formation. |
| | Topic 3.2. Methods for protecting the ecological and geochemical stability of landscapes. |

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| Course title | <i>National and international aspects of radioactive waste management</i> |
| Course Workload, credit units /academic hours | 4/144 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| Waste containing radioactive isotopes of chemical elements | Topic 1.1. Legal regulation of relations in the field of radioactive waste management. |
| | Topic 1.2. Radioactive waste. Classification of radioactive waste. |
| Legal aspects of radioactive waste management | Topic 2.1. Powers of national governments in the field of radioactive waste management. Norms and rules governing the management of radioactive waste. |
| | Topic 2.2. Ownership of radioactive waste and radioactive waste storage facilities. Creation of a unified state system for handling radioactive waste. |
| Control and management of radioactive waste | Topic 3.1. Requirements for the disposal of radioactive waste. Handling of spent sealed sources of ionizing radiation. |
| | Topic 3.2. Carrying out radiation monitoring when handling radioactive waste. General requirements for organizations, as a result of whose activities radioactive waste is generated. Transportation of radioactive waste. |

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| Course title | <i>Psychology of management</i> |
| Course Workload, credit units /academic hours | 1/36 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| Leader as a Subject of Successful Management of Innovation Processes | Topic 1.1. Tasks, subject and object of the course in psychology of management Subjects of management of innovative processes in education |
| | Topic 1.2. Manager as a subject of management of innovative processes. Tablet for studying the innovative disposition of the leader's personality |

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| Group as a Subject of Successful Management of Innovation Processes | Topic 2.1. Group as a subject of innovation process management |
| | Topic 2.2. Tablet studying the innovative disposition of the group |
| The Team as a Subject of Successful Management of Innovative Processes | Topic 3.1. The team as a subject of management of innovative processes in education Tablet for studying the innovative disposition of the team |

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| Course title | <i>Ecotoxicokinetics of waste</i> |
| Course Workload, credit units /academic hours | 4/144 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| Раздел 1. Токсиканты в окружающей среде | Topic 1.1. Identification of sources of pollutants. Persistence of pollutants in the environment and distribution in the media. |
| Раздел 2. Биотрансформация химических веществ | Topic 2.1. Bioaccumulation of chemicals in living organisms and biomagnification. |
| | Topic 2.2. Bioavailability of heavy metals and arsenic in the "soil-plant" system. |
| | Topic 2.3. Abiotic degradation of chemicals in waste components. |
| | Topic 2.4. Biotic transformation of pollutants in waste components. Elimination of xenobiotics |

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| Course title | <i>MSW Recycling and Utilization Technics</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| 1. Collection, disposal and principles of solid waste processing | 1. Methods of collection and disposal of solid municipal waste (TMS). Principles of TCR processing. Characterization of TCR as an object of processing. |
| 2. Methods of grinding and briquetting (primary preparation). Methods of separation of TCR | 2. Processes of grinding and compacting TCR. TKO Separation: Crushing. Screening. Magnetic separation. Electrodynamics separation. Electrical separation. Aeroseparation. Special methods of separation. Manual sorting. Analysis of integrated process |

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| | separation schemes. Sanitary-microbiological and hygienic aspects of separation technology. Regulatory requirements for the initial preparation of TCR for processing. |
| 3. Thermal processing of TCR for the purpose of generating electricity and heat recovery | 3. General information. Classification of thermal processing methods. World experience of waste energy use. Ecological hazards of thermal processing methods. Methods for reducing and preventing pollution of the environment by gaseous emissions during thermal processing. Evaluation of methods of thermal processing. Fundamentals of gas cleaning. Biothermal treatment of TCR. Advantages and disadvantages. |
| 4. Methods and expediency of utilization of the main valuable fractions of TKO - black and non-ferrous metal, glass, plastics, paper. | 4. Consideration of aspects of the recycling of valuable fractions (self-study). Organization of territorial schemes for the management of waste taking into account the utilization of valuable TKO fractions. |

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| Course title | | <i>Regional & Municipal MSW Management Systems</i> |
| Course Workload, credit units /academic hours | | 4/144 |
| <i>Brief Course Content</i> | | |
| № п/п | Course Modules | Содержание раздела (темы) |
| 1. | World experience in the waste management system. Possible management scenarios | Indicators of sustainable development in the field of waste management. Basic principles of waste management. Stages of development of the waste management system in developed countries. Experience of Sweden, France, Japan. Features of regulation during waste incineration. The main methods of integrated waste management in the world. Waste Management System Optimization Global trends in waste management. |
| 2. | Waste - as a source of secondary resources and energy. | Goals and objectives of regional waste management programs, indicators used to implement programs, implementation results. Short and long term programs. Regional features to consider when developing programs. The composition of the waste. Analysis of resource and energy potential of waste |
| 3. | Mechanisms for improving the waste management system in the regions of the Russian Federation. Legal Basics of Waste Management | Improving the regulatory framework in the field of waste management .. Environmental tax and expanded responsibility of producers and importers of goods. Waste disposal fee. |

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| 4 | Institute of Extended Manufacturer Responsibility, environmental tax | Levels of hierarchy in waste management. Waste minimization - resource saving and low-waste technologies. Classification of municipal solid waste and the organization of a separate collection system. |
| 5 | Territorial (regional) waste management schemes. The role of municipal government | Territorial waste management schemes. Institute of Regional Operator. Determination of waste streams generated in various industries and utilities. Directions of the waste management strategy: creating conditions for reducing the amount of waste; ensuring the growth of waste use; creation of environmentally friendly conditions for storage and disposal of waste. |
| 6 | The best available technologies for the treatment, disposal and storage of waste | Technical reference books on BAT. Selection criteria for BAT. Modern technologies for processing, sorting, and neutralizing waste. Waste inventory. Databases and expert waste management systems. Mapping information. Waste catalog |
| 7 | Integrated Solid Waste Management Schemes | The use of a complex of various methods of waste processing, focused on regional and industry applications. Integrated waste management schemes. The use of combinations of recycling, processing, composting and incineration of waste volumes. Flexibility of waste management structure. Comprehensive use of organizational, managerial, legal, regulatory and methodological, technical and economic means of waste management, monitoring of waste, implementation of promising scientific developments. Improving the technical level of waste processing and the creation and implementation of low-waste technologies. |
| 8 | Principles of economic regulation and incentives in the field of waste management. | Fee for waste disposal (a form of compensation for damage to the environment), payment for waste disposal within the established limits and payment for over-limit placement - from the profit of the enterprise. Economic incentives for waste management. Tax and credit benefits |

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| Course title | <i>Mapping and GIS-technologies in MSW Management</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |

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| Introduction | Geographic information system as a basis for system analysis of geographically referenced information |
| Basic principles of remote sensing, classification of remote sensing methods | GIS architecture. Data types. Hierarchy of objects. DBMS |
| Methods for solving problems using remote sensing and GIS tools | Various methods for entering information. Ability to manipulate and manage information. Tools for the analysis and visualization of information. |
| Ways to solve problems | Decision support. Simulation of various situations. Solution of predictive tasks. Implementation of GIS for waste management in the city GIS. Examples of creating a GIS for MSW management for specific regions / municipalities |

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| Course title | <i>Remote Sensing of MSW objects</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| Introduction | Possibilities of the remote sensing method, the need for and justification for the use of remote sensing to optimize the waste management system |
| Principles of remote sensing | Physical basis of remote sensing, types of remote sensing, classification of remote sensing methods. Principles of interpretation of satellite images. Databases of satellite information. Information processing methods. |
| Methods of solution of problems by the means of remote sensing and GIS | Software for remote sensing data processing, variety of GIS, types of tasks solved with the help of GIS, spatial analysis of GIS, hierarchy analysis method (HAI) |
| Case studies on the use of remote sensing tools for the purpose of waste management | Cases on the use of remote sensing tools for the management of waste management facilities USA, Nigeria, Japan, China. Examples of solving practical problems |

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| Course title | <i>Green Economy and Tools for Enterprises Sustainable Development</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |

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| Course Modules | Course Modules and Contents: |
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| Fundamentals of a green economy | Topic 1.1. The concept and essence of the "green" economy. The international context for the formation of a "green" economy. |
| | Topic 1.2. The concept of the circular economy: its origins and evolution. Industrial ecology. The concept of "From cradle to cradle". Circular economy. Blue economy. Biomimicry. |
| From a linear economy to a circular economy | Topic 2.1. Limits of development of linear economy. Barriers and drivers of circular economy development. Environmental, resource, economic and social benefits of a circular economy. |
| | Topic 2.2. Basic principles and mechanisms of the circular economy. Possibilities of material recycling. Types of cycles within the green economy. Ways to preserve the value of products. New cyclical business models. |
| | Topic 2.3. Fundamentals of green growth. Methodological approaches to assessing the potential of green growth of territories and regions. |
| Economic Valuation of Ecosystem Services | Topic 3.1. Types of capital involved in the green economy. The concept of ecosystem services. Classification of ecosystem services. Use of remote sensing technologies in the valuation of ecosystem services An overview of approaches to the economic valuation of ecosystem services. |
| Product life cycle assessment as one of the tools of the circular economy | Topic 4.1. Using the Product Life Cycle Assessment (LCA) Toolkit to Create a Circular Economy. production system. single processes. OZHCP: basic concepts, stages. Application of life cycle assessment to industrial symbioses. |
| Enterprises Sustainable Development | Topic 5.1. Definitions of sustainable development of enterprises. Components of sustainable development of enterprises: economic sustainability, social responsibility, environmental performance |
| | Topic 5.2. Corporate Social Responsibility and Environmental Efficiency The concept of corporate social responsibility (CSR). Evolution of views on the role of business in society. CSR principles. Elements of CSR. Models and standards of CSR. Evaluation of the social efficiency of enterprises. Non-financial reporting of the enterprise. Evaluation of the environmental efficiency of the enterprise. ISO 14031 |

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| Course title | <i>Basics of Circular Economics</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |
| Course Modules | Course Modules and Contents: |
| 1. Essence and content of a green or circular economy | Economic content of green economy and sustainable development. Definition of green economy and sustainable development. Functions, goals and objectives of the green economy. The concept and current trends in the development of the circular economy. |
| 2. Economic mechanisms for environmental protection and transition to a green economy | Principles and tools of "green economy" and its contribution to the transition to sustainable development. Indicators of sustainable development. OECD indicator systems. UNCSD indicator systems. Economic levers of implementation. Payment for negative impact on the environment. Environmental fee and manufacturer's responsibility. Environmental entrepreneurship. Ecological insurance. State support for economic and (or) other activities carried out for the purpose of environmental protection. Basic legal documents regulating environmental principles. |
| 3. Economic value of nature and efficiency of nature management | The need to determine the economic value of nature. National wealth and its composition. Indicators of national wealth (method of the World Bank). Accounting for the environmental factor in the main indicators of economic development. Implementation of the principles of green development: "polluter pays (PP)" and implementation of the 3R policy. The concept of consumer surplus. |
| 4. Conditions and opportunities for the transformation of the technogenic type of economic development into a circular economy | The need for a transition to a sustainable type of development and the introduction of elements of a "green" economy. Limitations of technogenic development: environmental (degradation and depletion of natural resources, pollution and waste), economic (investment), social (ill health, environmental migrants). Alternative options for solving environmental problems; development of low-waste and resource-saving technologies; technological changes; direct environmental protection measures. Reducing the share of natural resource industries and increasing the share of knowledge-intensive high-tech industries |

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| 5. Legislation in the field of environmental protection and the concept of “best available technology (BAT)” | Mechanisms for the implementation of environmental and economic policy: direct regulation (state influence), economic incentives (market mechanisms), mixed mechanisms. Formation of environmental legislation. The role of the state in the formation of a circular economy |
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| Course title | <i>Physicochemical methods of waste testing</i> |
| Course Workload, credit units /academic hours | 3/108 |
| Brief Course Content | |
| Course Modules | Содержание раздела (темы) |
| 1. Sources of environmental pollution. | 1. Sources of pollution - natural and man-made. Their interplay and contrast. |
| 2. Ensuring environmental safety in the handling of waste | 2. Environmental safety, as a set of chemical, biological, radiological and spontaneously due to planetary security. The main types of chemical safety and the causes of toxicity of substances and materials. |
| 3. Methods for monitoring waste components | 3. Classification of control methods of environmental components of the environment. Instrumental methods and techniques of biomonitoring. Classification of instrumental methods. |
| 4. Methods of bioindication and biological testing | 4. Basics of biomonitoring. Bioindication and biological testing. Their commonality and differences. biomonitoring Applications. |
| 5. Optical and spectral methods of control components of the waste, leachate and state components of the environment. | 5. The fluorescence and other optical techniques. Radiospectroscopy as the most informative analysis of substances region. The spectral parameters and their relation to the structure and properties of substances. Mass spectrometry, as the most sensitive method for the analysis instrument. Apparatus for isotope and molecular mass spectrometry. |
| 6. Explanation of the spectra. | 6. The parameters of the spectra and their application |
| 7. Identification of waste components | 7. Identification of waste components. Requirements for the selection, transportation and storage of samples of waste production and consumption. Algorithms sharing tools and methods of biomonitoring for environmental monitoring, assessment and prediction of its properties. |

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| 8. Calculation and experimental methods for determining the hazard class of toxic waste | 8. Calculation method for determining the hazard class of toxic waste production and consumption. The experimental method of determining the hazard class of toxic wastes of production and consumption. Toxicological, hygienic and physico-chemical parameters of waste components. |
| 9. Indicators of waste components. | 9. Classification of waste on human health and the human environment. Indicators of risks and concentrations of individual components of the waste. |
| 10. Migration of components of the waste in the environment | 10. The calculation of the indicative water-migration index. The calculation of the concentration of volatile components in the waste air. Environmental and health indicators and criteria for classification as waste hazard classes. |

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| Course title | | <i>Environmental control and MSW monitoring programs</i> |
| Course Workload, credit units /academic hours | | 3/108 |
| Brief Course Content | | |
| № п/п | Course Modules | Содержание раздела (темы) |
| 1. | Theoretical and methodological foundations of waste management. Monitoring programs. | Human influence on the change in the cycles of substances and energy flows in the environment. Natural resource potential of production. Agroclimatic resources. Biological resources. Current state and features of use. Resource cycles; their classification and features of functioning. The nature of the cycle of production raw materials. Biogeochemical cycles. The volume of production of polluting products and their distribution in the environment, their stability and their ability to decompose. Conversion of harmful substances. Ecological passport of an industrial enterprise. Assessment of environmental friendliness of production, consumption of raw materials, energy, natural resources. Pollutant emissions (pollutants) per unit of output. |
| 2. | Ecological and analytical control and monitoring of environmental components | The environmental impact of chemical pollutants on environmental components. Procedures and operations of the technological cycle of chemical-analytical control of environmental pollution. Chemical and physico-chemical methods of ecological and analytical control of environmental |

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| | | components. Spectral control methods. Spectral parameters and their relationship with the structure and properties of substances. Mass spectrometry as the most sensitive instrumental analysis method. Equipment for isotopic and molecular mass spectrometry. Deciphering the spectra. |
| 3. | Features of ensuring environmental safety in the field of MSW management (IV and V hazard classes) | Organization and implementation of control and supervision of activities in the field of waste management. Rationing of anthropogenic load on landscapes. Priority environmental impacts of production and waste processing industries. Environmental requirements for the placement of MSW landfills. Incinerators. Garbage sorting complexes. Transshipment stations. Controlled component indicators and control methods used. Organization of local monitoring systems |
| 4 | Ensuring the environmental safety of hazardous waste management facilities (I-III hazard classes) | Ensuring the safety of the disposal of highly hazardous waste. Controlled parameters. Warehousing and temporary storage of highly hazardous waste. Methods of control and monitoring. |
| 5 | Mathematical modeling and prediction of dynamic processes in ecosystems | Methods for forecasting environment quality changes at local and global level. Fundamentals of mathematical modeling. Simulation models. Calculation models, use of software systems. Verification of models. Methods for identifying the dynamics and patterns of changes in the state of the environment |

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| Course title | | <i>Foreign language</i> |
| Course Workload, credit units /academic hours | | 6/216 |
| <i>Brief Course Content</i> | | |
| № п/п | Course Modules | Содержание раздела (темы) |
| 1. | Introductory Phonetic and Grammar Course | Topic 1.1. Pronunciation and spelling Topic 1.2. Introductory Listening and Speaking Course Topic 1.3. Plural formation of nouns. Expression of request |
| 2. | A basic level | Topic 2.1. The gender of nouns. Possessive pronouns. Topic 2.2. Expression of time in a simple sentence) Topic 2.3. The concept of the Russian verb. Instrumental case of nouns. Topic 2.4 Instrumental case of nouns. Verb WANT Topic 2.5. A model for the formation of the past tense from verbs with constant stress based on |

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| | | <p>Topic 2.6. Model of the formation of the past tense from verbs with variable stress.</p> <p>Topic 2.7. Constructions need + infinitive, you can + infinitive, What you need (can) + infinitive</p> <p>Topic 2.8. Compound future tense of verbs.</p> <p>Topic 2.9. The verb to learn in the present, past and future tenses.</p> <p>Topic 2.10. The verb is to speak in the present, past and future tenses. Imperative.</p> <p>Topic 2.11. The verb to teach is in the present, past and future tenses.</p> <p>Topic 2.12. Expression of the absence of the subject (it does not exist). Telephone etiquette.</p> <p>Topic 2.13. Constructions I have (was, will be) and I do not have (was not, will not be).</p> <p>Topic 2.14. I like the design. Comparison of typical contexts for the use of the verbs love and like.</p> <p>Topic 2.15. Prepositional case of place.</p> <p>Topic 2.16. The expression of time in a simple sentence. Prepositional verbs.</p> <p>Topic 2.17. Telephone etiquette. Formation of a simple comparative degree of adverbs</p> <p>Topic 2.18. Instrumental case in the meaning of action compatibility</p> <p>Topic 2.19. General idea of verbs of motion. Accusative case to indicate the direction of movement.</p> <p>Topic 2.20. Group verbs go and walk in the future and past tenses.</p> <p>Topic 2.21. Ordinals. Time structures.</p> <p>Topic 2.22. Genitive case to indicate direction (with the question from where?).</p> <p>Topic 2.23. Verbs of motion go, go, go, go, come, arrive, walk, drive.</p> <p>Topic 2.24. verb to return. Features of the conjugation of verbs with the particle -sya ..</p> <p>Topic 2.25. Telephone etiquette. The formation and use of forms of the imperative mood with the word let.</p> |
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HEAD OF THE HIGHER EDUCATION PROGRAM:

Senior Lecturer
 Department of Environmental
 Safety and Product Quality
 Management



Popkova A.V.

Position

Signature

Full name