MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

Sumy State University

PROGRAM
of the entrance exam for admission to study
to obtain the degree of "Doctor of Philosophy"
in the specialty 183 "Environmental Protection Technologies"

1. GENERAL PROVISIONS

The entrance exam for admission to the degree of Doctor of Philosophy in the specialty 183 "Environmental Protection Technologies" is conducted to assess the readiness of the applicant to obtain the degree of Doctor of Philosophy in this specialty. The following sections are included in the entrance exam: environmental monitoring, modeling and forecasting of the environment, environmental safety, basics of environmental protection technologies, technoecology, environmental impact assessment, technologies for the utilization and disposal of industrial waste, processes and devices of environmental technologies, environmental biotechnology, and sustainable development strategy.

The test lasts 80 minutes.

2. TYPICAL QUESTIONS FROM THE SECTIONS COVERED IN THE EXAM

Environmental monitoring: Global environmental monitoring system. Types and levels of monitoring. Organization of the state environmental monitoring system in Ukraine. The system of state air monitoring in Ukraine (definition, object, system goals, objectives, structure). The system of state water monitoring in Ukraine (definition, object, purpose, objectives, structure). State land monitoring system in Ukraine (definition, object, purpose, tasks, structure).

Modeling and forecasting of the environment: Modeling of the main indicators for assessing the level of air pollution from stationary sources. Modeling of the main indicators for assessing water pollution by wastewater discharges from stationary sources.

Environmental safety: The most important global problems of mankind, causes, and solutions. Environmental indicators characterizing the state of the geosystem. Classification of environmental situations, scheme of formation, factors

taken into account in the assessment of environmental situations. Types of anthropogenic environmental pollution. Nature of occurrence, impact on the environment and humans. The role of economic sectors in the emergence of environmental problems. Environmental consequences of military operations. Environmental emergencies. The relationship between danger and security. Methodology of risk analysis and assessment. Environmental situations: types, general scheme of formation. Measures to prevent and overcome environmental emergencies.

Basics of environmental protection technologies: Alternative energy sources. Biotechnology - the standard of waste-free production. Geotechnology. Purification of industrial emissions from acidic impurities (CO_2, H_2S, SO_2, NO_x). Methods and devices for cleaning gas emissions from solid particles. Environmental impacts of industries and methods of protection: oil and gas industry, transportation, chemical industry, energy. Mechanical methods of wastewater treatment (filtration, sedimentation). Methods of intensification of settling processes (coagulation, flocculation). Wastewater treatment by flotation and electroflotation. Electrochemical methods of wastewater treatment.

Technoecology: Environmental consequences of biosphere pollution. Geotechnology. Environmental impacts of industries and methods of protection: oil and gas industry, transportation, chemical industry, electricity, metallurgy and machine-building, construction materials, forestry, woodworking and pulp and paper industry, light industry, housing and utilities. Low-waste and zero-waste production.

Technologies for utilization and disposal of industrial waste: Waste generation and characteristics. Waste management hierarchy. Mechanical methods of preparation and recovery (utilization) of waste. Principles of operation of electric and magnetic separation plants in the preparation of waste for treatment. Thermal methods of waste recovery (utilization): incineration, gasification, pyrolysis. Biological methods of waste treatment: composting, anaerobic treatment. Methods of recovery (utilization) of polymeric waste. Methods of recovery (utilization) of rubber waste. Methods of medical waste treatment. Methods of treatment of animal waste. Methods of treatment of waste oils. Methods of preparation and treatment of household waste: sorting, mechanical and biological processing, incineration.

Environmental impact assessment: Environmental impact assessment procedure. Timing and stages of the impact assessment procedure. Strategic environmental assessment. Methods for assessing the impact on ecosystem components (atmosphere, water resources, geological environment, soils, nature reserves).

Processes and devices of environmental technologies: Fundamentals of applied hydraulics. Separation of heterogeneous systems. Heat exchange processes. Evaporation and condensation. Mass transfer processes. Absorption. Adsorption. Ion exchange. Extraction. Membrane separation.

Environmental biotechnology: Biological agents and substrates of biotechnology. Overview of the areas of application of biotechnological processes. Hardware equipment of biotechnological processes. Biochemical processes of gas flow purification. Bioremediation of contaminated environments. Environmental safety of biotechnology production.

Sustainable development strategy: Sustainable development: formation of the concept, global problems, documents of the world community. Quantitative assessment of sustainable development of society.

3. STRUCTURE OF EXAMINATION TASKS

The ticket structure includes 50 questions of the same difficulty level (an average of 5 questions from each section). Each question contains one correct answer. A sample exam task and answer sheet are provided in Appendices 1 and 2.

4. CRITERIA FOR EVALUATING ANSWERS

The Commission evaluates the applicant's written answers to the test tasks on a 100-200-point scale. Applicants who score less than 100 points receive an unsatisfactory grade and are not allowed to participate in the competitive selection process. Applicants with 100 or more points are allowed to participate in the competitive selection.

To obtain a positive score in the professional exam, an applicant must pass the minimum test threshold of 30% of the total number of test points.

Test points are awarded for each correct answer to a task, and 0 points are awarded for an incorrect answer. The obtained test scores for the professional exam are converted to a 100-200 point scale (rounded to the nearest whole, according to the rules of mathematical rounding) according to the following algorithm:

$$O = O_{min} + k \cdot (N - r \cdot T), \text{ where}$$

O	score from a professional entrance examination on a scale of 100-200 points;
O_{min}	minimum score from the professional entrance examination on a scale of 100-200 points, at which the applicant is allowed to participate in the competitive selection;
k	the coefficient of conversion of test scores to a scale of 100-200 points, where:

$$k = 100 / (T \cdot (1 - r))$$

r	minimum permissible test threshold with an accuracy of 0.01, which is set in the range from 0 to 1, but not less than 0.10;
T	the total number of test points that an applicant can receive during a professional entrance examination;
N	the number of test points that the applicant received during the professional exam.

Provided that if the number of test scores received by the applicant during the professional exam (N) is "0", the applicant receives an unsatisfactory grade and is not allowed to further participate in the competitive selection.

Calculating test points

Each correct answer to a test question is worth 2 test points. Wrong answer is worth 0 points.

The total number of test points (T) that an applicant can receive during the professional exam is 100 test points.

The number of test points for the professional exam (N) is calculated as the sum of test scores excluding test scores taken off for corrections in the answer sheet (if provided by the program)..

Corrections policy

For each correction, 1 test point is deducted from the total number of test points (T) that an applicant can receive at the professional exam.

5. REFERENCES

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Approved at the meeting of the Admissions Committee.

Protocol № **11**   dated **08 квітня** 2024.

Responsible Secretary
of the Admissions Committee   Ihor ROY

Head of the Subject Commission   Leonid PLYATSUK

Sumy State University

APPROVED
Head of the Admissions Committee

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_____ 2024

EXAMINATION TASK
of the entrance exam for admission to study
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Variant №

1. Consequences of the impact of petroleum products on the environment:
A. greenhouse effect
B. oppression and death of biota, changes in heat and moisture exchange
C. acid precipitation
D. fluoride emissions

2. The global environmental monitoring system was launched in
A. 1972
B. 1974
C. 1975
D. 1980

3. Environmental safety is a balanced state of the system
A. nature - technology - man
B. lithosphere - hydrosphere - atmosphere
C. man - production
D. man - society

4. What type of source does a smoldering waste heap belong to?
A. linear source
B. group source
C. single source
D. plane source

5. The main apparatus for biological wastewater treatment is:
A. biodisk
B. biofilter
C. aerofilter
D. aerotank

6. When is the environmental impact assessment procedure carried out?
A. before making a decision to carry out the planned activity
B. after the decision to carry out the planned activity is made
C. at the stage of implementation of the planned activity
D. in case of dangerous and emergency situations at the facility

7. The yield of liquid products of pyrolysis of waste rubber is the highest at the temperature, °C:
A. 450-550
B. 500-600
C. 700-800
D. 800-900

8. Electrostatic precipitators are the best for cleaning:
A. coarse dust
B. high resistivity dust
C. fine dust
D. medium resistivity dust

9. Sustainable development indicators are:
A. qualitative indicators to characterize environmental pollution
B. qualitative and quantitative characteristics of the social and environmental sphere
C. qualitative and quantitative indicators of environmental monitoring
D. qualitative and quantitative indicators for assessing the state of the economic, social and environmental spheres

10. The main component of synthesis gas produced by waste utilization by gasification is:
A. methane (CH_4)
B. carbon dioxide (CO_2)
C. carbon monoxide (CO)
D. nitrogen oxides (NO_x)

11. Personal protective equipment includes:
A. rubber gloves
B. work vehicles
C. personal hygiene products
D. lead screens

12. The following can be used as raw materials for the production of dry animal feed:
A. contents of the digestive tract of farm animals
B. carcasses of animals belonging to by-products of animal origin of category II
C. by-products of animal origin of category I after their disinfection
D. carcasses of animals belonging to by-products of animal origin of category III

13. The definition of "Monitoring is a system of repeated observations of one or more environmental elements in space and time for specific purposes in accordance with a pre-prepared program" is given by:
A. The United Nations Conference on the Environment
B. UNEP
C. Academician Y.A. Israel
D. Ministry of the Environment

14. The reasonable coexistence of the biosphere and the technosphere in the concept of sustainable development is:
A. the idea of eco-evolution
B. the idea of the need for self-restraint
C. the idea of supertechnologies
D. the idea of total ecologization of life

15. As the height of the emission source increases, the range of pollutant transport
A. increases
B. does not change
C. decreases
D. the height of the source does not affect the range of pollutant transport

16. The substrate for cultivation of biotechnological objects can be:
A. sand
B. sulfuric acid
C. water
D. organic waste

17. In order to initiate the environmental impact assessment procedure, a business entity shall submit to the authorized state authority
A. a petition with a request to consider its application
B. notification of intentions to carry out the planned economic activity
C. a report on the environmental impact assessment of the planned economic activity
D. the results of an environmental assessment of an existing production facility

18. Large reinforced concrete tanks in which wastewater mixed with activated sludge is oxygenated by blowing air through them are called ...
A. aeration tanks
B. digesters
C. sand traps
D. settling tanks

19. What is the driving force behind the process of filtration?
A. difference in density
B. pressure difference
C. difference in temperature
D. difference in concentration

20. What does the term "life expectancy" mean?
A. experts' calculation of the impact of negative factors on life expectancy
B. calculation of probable mortality rates in the foreseeable future
C. there is no correct answer
D. extrapolation of the average life expectancy of past generations to the present and the next period

21. The main sources of carbon monoxide emissions:
A. burning of organic fuels, forest fires
B. domestic and industrial wastewater
C. iron ore mining
D. human breathing

22. Mark the correct statement regarding the treatment of waste by pyrolysis:
A. to intensify the process of waste treatment, the pyrolysis chamber is forced to supply oxygen or air containing oxygen
B. the pyrolysis method cannot be used for the treatment of hazardous waste
C. pyrolysis method is used for thermal decomposition of waste without access to oxygen
D. to prevent the formation of dioxins in the pyrolysis chamber, it is necessary to ensure a temperature of at least 1200 degrees Celsius

23. enterprises, institutions and organizations whose activities lead or may lead to environmental degradation shall be obliged to
A. provide information to the public
B. to exercise environmental control over production processes
C. monitor the health of employees
D. develop resource-saving technologies

24. Using the axiom "everything affects everything", give an example of the technosphere → natural environment nexus:
A. solid production waste
B. human error
C. decrease in the birth rate
D. earthquake

25. In scattering calculations, the grid spacing is determined depending on:
A. hazard class of the enterprise
B. number of emission sources
C. annual emissions of pollutants at the enterprise
D. the highest source of emissions

26. The objects (agents) of biotechnology are:
A. isolated cells
B. organic acids
C. soil
D. inorganic acids

27. To assess the impact of a planned activity on climate change, emissions are calculated:
A. greenhouse gases
B. gases with the highest toxicity of all emitted gases
C. gases that have a summation effect
D. methane and hydrogen sulfide

28. What is the average efficiency of particulate matter capture by cyclones (in percent)?
A. 84
B. 97
C. 65
D. 58

29. How does reducing the diameter of a cyclone affect the efficiency of waste gas cleaning?
A. the efficiency increases
B. depends on the particle diameter
C. does not affect
D. the efficiency decreases

30. Which of the following groups of indicators are indicators of the environmental dimension in Ukraine?
A. water quality, waste generation and utilization, participation in environmental projects, transboundary environmental pressure
B. radiation and environmental hazards, prospects for the development of society, labor market, level of education
C. gross national product, international trade cooperation, scientific activity, transport infrastructure
D. quality of society development, economic component of human development, state of the environment, state of infrastructure

31. The main component of biogas produced during the recovery (utilization) of biowaste in a biogas plant:
A. carbon monoxide (CO)
B. carbon dioxide (CO_2)
C. nitrogen oxides (NO_x)
D. methane (CH_4)

32. What types of waste can be processed using extrusion?
A. waste thermosetting polymeric materials
B. any waste that is not hazardous
C. medical waste for disinfection
D. waste of thermoplastic polymeric materials

33. It is mandatory to determine the presence of pollutants in the air:
A. specified in the list B
B. present in the emissions of industrial enterprises
C. specified in list A.
D. specified in lists A and B

34. Using the example of the scientific topic "The use of pellets as an alternative fuel", what will be the subject of research from the point of view of environmental safety:
A. shape
B. caloric content
C. color
D. quantity

35. Evaluate the sanitary condition of the reservoir in terms of the effect of summation, if the water contains nitrates in nitrogen 8 mg/L (MPC = 10 mg/L) and toluene 0.41 mg/L (MPC = 0.5 mg/L). The effect of the total effect of these substances is as follows:
A. 1.12
B. 1.62
C. 1.74
D. 1.83

36. Scoping in the environmental impact assessment procedure is:
A. the procedure for determining the scope of research and the level of detail of information to be included in the environmental impact assessment report
B. the procedure of public discussion of the environmental impact assessment report
C. the procedure for identifying alternative types of planned activities
D. the procedure for preparing a decision based on the results of the environmental impact assessment report

37. The rate of sedimentation of coarse impurities during their settling depends to the greatest extent on:
A. the density of the particles
B. viscosity of the solvent
C. diameter of the settling tank
D. diameter of the particles

38. The purpose of a sustainable development strategy is to:
A. regulation of the number of living organisms
B. reducing the use of natural resources
C. regulation of the pace of natural resources use
D. all answers are correct

39. Light industry (knitting, fur, leather, etc.) is the most polluting:
A. the air basin
B. water environment
C. soil
D. groundwater

40. Light industry (knitting, fur, leather, etc.) is the most polluting:
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C. soil
D. groundwater

41. The object of land monitoring is
A. lands of the reserve fund
B. all lands regardless of their form of ownership
C. state-owned land
D. agricultural land

42. At what stage of the model building process is the object formalization procedure performed?
A. conceptualization
B. mathematical description
C. analysis
D. building a scientific model

43. Objects (agents) of biotechnology are:
A. plants
B. enzymes
C. soil
D. inorganic acids

44. Strategic environmental assessment differs from environmental impact assessment:
A. objects to be assessed
B. absence of public discussion procedures
C. determination of transboundary impacts
D. absence of the report preparation stage

45. The main apparatus for biological wastewater treatment is:
A. biodisk
B. biofilter
C. metatank
D. aerotank

46. The Langmuir equation is used to describe the equilibrium of
A. regardless of the type of adsorption
B. in physical adsorption
C. in desorption
D. in chemical adsorption

47. Which law determines the rate of deposition of particles?
A. Stokes' law
B. Amag's law
C. Archimedes' law
D. Newton's law

48. The sustainable development strategy includes:
A. strategic goals
B. strategic directions and tasks
C. strategic objectives and indicators for monitoring the strategy
D. strategic directions, goals and objectives

49. Low potential heat waste includes physical heat:
A. combustible waste from chemical and thermo-chemical processing of hydrocarbon raw materials
B. flue gases of technological and energy installations with a temperature below 400 °C
C. gases coming out of technological units with excessive pressure
D. alkaline solutions from pulp and paper production

50. Which waste components can be removed from a mixture using a magnetic separator:
A. paper
B. ferrous metals
C. non-ferrous metals
D. polymeric materials

Head of the Subject Commission _____ Leonid PLYATSUK

SUMY STATE UNIVERSITY

Code _____

ANSWER SHEET
of the entrance exam for admission to study
to obtain the degree of "Doctor of Philosophy"
in the specialty 183 "Environmental Protection Technologies"

Variant №

№	A	B	C	D	№	A	B	C	D	№	A	B	C	D	№	A	B	C	D
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13	□	□	□	□	26	□	□	□	□										

Number of correct answers _____ :   Number of points for them _____ :

Number of corrections _____ :   Points deducted for corrections _____ :

Total points including deductions – _____
(by number and spelling)

Head of Committee   _____   _____
                           (signature)   (last name, initials)

Members of Committee   _____   _____
                           (signature)   (last name, initials)

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                           (signature)   (last name, initials)