HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

MSc PROGRAM

«ENVIRONMENTAL SCIENCES AND PUBLIC HEALTH»

STUDY GUIDE

2023-2024

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National and Kapodistrian University of Athens

School of Physical Sciences

Department of Chemistry

Master's Program

"Environmental Sciences and Public Health"

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GENERAL INFORMATION

General Description

The establishment of the specific specialization in the postgraduate program was based on the Department of Chemistry's extensive experience gained from over fourteen years of operating the "Chemical Analysis-Quality Control" specialization within the interinstitutional postgraduate program of the Department of Chemistry at the National and Kapodistrian University of Athens (NKUA), in collaboration with the Department of Chemistry at the Aristotle University of Thessaloniki (AUTH). This specialization was active until the academic year 2017-2018. Additionally, insights were drawn from the three-year experience of the "Analytical Chemistry-Quality Assurance" specialization within the postgraduate program of the Department of Chemistry at NKUA.

The specializations offered in the postgraduate program of the Department of Chemistry at NKUA have demonstrated exceptional success. This is evident from the continuously increasing number of student applicants, the publication of high-quality thesis works in reputable international scientific journals, and the successful professional integration of graduates. By attaining a competitive postgraduate degree, graduates are immediately able to seek employment in organizations within the corresponding scientific fields of the postgraduate program, as well as in public and private sectors, domestic and international research centers. Graduates can also pursue further studies with the aim of completing a doctoral thesis in Greece and/or abroad, advancing knowledge in their field.

The undergraduate education of chemists in the fields of inorganic analysis, modern analytical techniques, biochemistry, environmental chemistry, toxicology, and clinical chemistry encompasses the provision of theoretical knowledge. However, practical laboratory exercises and studies, which are evident and noteworthy, are conducted using basic educational resources rather than cutting-edge equipment. Consequently, the organization of postgraduate training for young scientists in this specialization is deemed essential and will guarantee the most effective preparation for their swift integration into highly specialized and high-value positions in various professional domains within the private and public sectors, as well as in organizations associated with environmental sciences and public health.

Subject – Objective

The objective of the M.Sc. program "Environmental Sciences and Public Health" is two-fold. On the one hand, it aims to advance scientific knowledge and the application of

new knowledge and technology in addressing the emerging environmental risks and the challenges posed by the climate crisis in the 21st century. On the other hand, it focuses on the specialization of young scientists with an emphasis on the environment, public health, and the interconnectedness and mutual influence of these fields. Furthermore, the training of personnel and public officials capable of tackling climate change management, disasters and crises, epidemiological challenges, and public health issues in general, with the goal of contributing to the economic and social development of the country and the international economic environment, is an overarching objective of the M.Sc. program.

The international M.Sc. program consists of coursework, laboratory exercises, and research projects, providing both practical and theoretical training for the application of scientific and technological knowledge and skills in the fields of environmental sciences and public health. Specifically, the program focuses on studying emerging chemical and biological hazards and their assessment, as well as strategies for public health adaptation (secondary prevention) and mitigation (primary prevention) to reduce the adverse impacts of climate change on health. The program also investigates the roles of toxicology and risk assessment in ecosystem and public health protection, with a particular emphasis on 21st-century techniques, challenges, methodologies, interpretation, applications, and communication related to the use of emerging risk assessment in public health. Moreover, the program explores the fundamental interconnections of the "climate-energy-water-food-health-waste" nexus, which leads to the development of truly sustainable products, processes, and production systems. To comprehend the relationships between diseases and environmental factors, the program examines OMICs approaches (metabolomics, lipidomics, proteomics, genomics) utilizing state-of-the-art technologies such as high-resolution mass spectrometry and ion mobility spectrometry.

The management, analysis, interpretation, and integration of multi-omics data represent another significant learning challenge to be addressed through the application of modern machine learning and artificial intelligence approaches. Additionally, applications of epidemiological principles and methods will be examined to study environmental exposures and their adverse health outcomes. The primary focus is on environmental exposures, including both physical and chemical exposures, such as emerging chemical pollutants, pesticides, atmospheric pollution, radiation, etc.

The comprehensive assessment of environmental exposures will be enhanced through the study of fundamental concepts from various disciplines, such as

microbiology, immunology, genomics, biology, toxicology, occupational health, climate science, justice, and health policy. Special attention will be given to the study of exposure to atmospheric pollution, which is a key contributor to the global burden of diseases.

Water quality will also be a focus of the M.Sc. program, as it will cover the fundamental principles of water treatment units aiming to develop critical thinking and problem-solving skills in the field of engineering. Environmental justice principles, quantitative methods, and the exploration of causes and consequences of environmental health inequalities will be a

separate subject of study. Additionally, contemporary approaches governing Environmental Law and leading to regulatory climate mitigation strategies will be presented and evaluated.

Lastly, operational plans will be examined for responding to domestic and international public health situations and medical emergencies.

Postgraduate Degree

The M.Sc. program awards a Master's Degree (M.Sc.) in "Environmental Sciences and Public Health" upon successful completion of the program according to the approved curriculum. The degree is conferred by the Department of Chemistry at the National and Kapodistrian University of Athens

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Enrollment in the M.Sc. Program

In order to obtain the M.Sc. degree, a total of one hundred and twenty (120) credit units (ECTS) are required.

Throughout their studies, postgraduate students are required to attend and successfully pass postgraduate courses, engage in research activities, and write scientific papers. They are also expected to complete a Master's thesis.

All courses are exclusively conducted in English, and the Master's thesis is also written solely in English.

The duration for the award of the Master's Degree (M.Sc.) in the Program is set at four (4) academic semesters.

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Course Program

The M.Sc. program commences in the winter semester of each academic year.

To obtain the M.Sc. degree, a total of one hundred and twenty (120) credit units (ECTS) are required.

During the course of their studies, postgraduate students are required to attend and successfully complete postgraduate courses, engage in research activities, and write and present scientific papers. Additionally, they are expected to conduct independent research for their Master's thesis.

Teaching is delivered through a combination of in-person classes and distance learning methods, as needed. However, the proportion of distance learning should not exceed 35% in accordance with the current law (paragraph 3, article 30, Law 4485/2017).

Courses are organized into semesters, following a weekly schedule, and are conducted exclusively in English.

A. The course program is structured as follows:

Semester 1		
Compulsory courses	**Teaching hours/week**	**ECTS**
Climate Changes and Health	2	5
Environmental Toxicology and Risk Assessment	2	5
Sustainable Systems Design	2	5
Bioanalytical Methods and Machine Learning for Multiomics	2	5
Environmental Epidemiology	2	5
Systems Approaches for Environmental Health Sciences	2	5
Total		**30**

Semester 2		
Compulsory Courses	**Teaching hours/week**	**ECTS**
Cross-talk Between Environment and Infectious Diseases	2	5
Water Quality Control	2	5
Air Pollution: Health Effects and Air Quality	2	5

Environmental Justice and Health Disparities	2	5
Environmental Law and Science Communication	2	5
Environmental Disasters: From Hurricanes to Wildfires	2	5
Total		**30**

Semester 3	**ECTS**
Research Methodology & Laboratory Practice at "Environmental Sciences and Public Health'' - Bibliographic Research	30
Total	**30**

Semester 4	**ECTS**
Writing of a postgraduate thesis (MS) "Environmental Sciences and Public Health''	30
Total	**30**

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DETAILED DESCRIPTION OF COURSE CONTENT

1st Year of Studies

1st Semester

COURSE: "Climate Changes and Health"

After contextualizing climate change within the framework of the Anthropocene, planetary boundaries, and planetary health, and examining the fundamental principles of climate change science, this course explores the repercussions of climate change on public health. It encompasses the effects of extreme heat, wildfires, hurricanes, floods, infectious diseases, population displacement, and mental health implications. The course delves into strategies for public health adaptation (secondary prevention) and mitigation (primary prevention) to minimize the adverse impacts of climate change on health. Additionally, it discusses the substantial non-climate-related direct health benefits resulting from these strategies. The course also incorporates topics of policy, vulnerability, and climate justice.

COURSE: "Environmental Toxicology and Risk Assessment"

The course is designed to serve as a foundation for understanding the role of toxicology and risk assessment in protecting public health, focusing on 21st-century techniques and challenges. Through lectures on the principles of toxicology, such as dose-response relationships, mechanisms of toxicity, and cellular defense, this course introduces advanced topics such as vulnerability in early life stages, low-level exposure to mixtures, systems biology approaches including high-throughput screening, computational toxicology, mechanisms of adverse outcomes, and green chemistry solutions to issues arising from common chemical substances found in consumer products and the built environment. Additionally, lectures on the methodology, interpretation, applications, and communication of risk assessment in public health are included.

COURSE: “Sustainable Systems Design”

As new sustainable technologies are being designed, invented, and implemented on a larger scale, the need for their design to be approached with a systemic mindset becomes imperative. It is widely recognized that the main challenges we face as a society are interconnected. Understanding the fundamental interconnections among climate, energy, water, food, health, and waste is essential for the development of truly sustainable products, processes, and production systems. The next generation of innovation will emerge from the

realization of the synergies that a circular, healthy, and bio-based economy can bring through careful design.

COURSE: “Bioanalytical Methods and Machine Learning for Multiomics”

Over the past decade, machine learning and artificial intelligence have made a tremendous impact on the academic, business, and industrial worlds, opening up multibillion-dollar markets that range from autonomous vehicles to speech recognition, machine translation, and data-driven precision medicine. The key components for utilizing machine learning methods to provide tangible academic and business benefits in environmental sciences are already in place: computational power has significantly increased, algorithms have become more advanced, and vast quantities of data are being generated.

Specifically, modern omics technologies such as genomics, transcriptomics, microbiomics, and metabolomics generate enormous volumes of raw data related to environmental exposure and deep human biology. Managing, analyzing, interpreting, and integrating such multi-omics data, which can easily amount to several gigabytes per sample, poses a significant challenge. Machine learning and neural networks are crucial for extracting actionable and comprehensive knowledge from diverse omics data, enabling the discovery of biological mechanisms influenced by environmental factors that impact human health.

COURSE: "Environmental Epidemiology"

The course is designed to focus on the application of principles and methods of epidemiology in studying environmental exposures and their adverse health outcomes. The main emphasis is on environmental exposures, including both physical and chemical exposures, such as environmental chemicals and pesticides, air pollution, radiation, etc. Attention is given to the design of population-based studies to investigate environmental issues and human health, critical review of scientific literature, interpretation of environmental epidemiological research data, identification of challenges involved in studying environmental exposures and human health, and analysis of data related to environmental exposures and human health. The interactions between genotype and environment are a crucial component in studying environmental risks in relation to human health, which will also be examined and discussed during the course.

COURSE: "Systems Approaches for Environmental Health Sciences "

Exposure to toxic substances from various environmental sources has a significant impact on public health and is considered a matter of utmost societal importance. The

adverse effects resulting from these toxic factors often arise from disruptions at the system level within networks of "molecular events." To fully understand the mechanisms of toxicity, it is crucial to initially identify the interactions between molecules, as well as the biological pathways and processes within these networks. In order to prepare future environmental health scientists and public health leaders to address emerging threats in these fields, a more comprehensive approach is needed to study these exposures and their consequences on health. Therefore, OMICs approaches (metabolomics, lipidomics, proteomics, genomics) are employed to comprehend the relationships between diseases and environmental factors. OMICs technologies allow researchers from different scientific disciplines to delineate molecular responses to stressors using an integrated approach. The application of OMICs, such as metabolomics and proteomics, relies on cutting-edge technologies such as high-resolution mass spectrometry and ion mobility spectrometry. By completing this course, students will be able to read and interpret scientific literature using these methods and explore how these approaches could be integrated into their own research.

2nd SEMESTER

COURSE: Cross-talk Between Environment and Infectious Diseases

Environmental exposures, including atmospheric pollution and infectious diseases, exert significant influence on the global burden of respiratory illnesses. However, these factors are typically studied in isolation. In order to advance the field and equip future environmental health scientists and public health leaders with the necessary tools to effectively address emerging threats in these domains, a more integrated approach is required to investigate these exposures and their implications for human health. Consequently, the development of an introductory course is proposed, aimed at providing environmental health scientists with a comprehensive understanding of key concepts from relevant disciplines pertaining to global lung health. This interdisciplinary curriculum would encompass topics such as microbiology, immunology, host-pathogen interactions, genomics, aerobiology, toxicology, occupational health, climate science, and health policy governance. Upon completion of this course, students will be well-prepared to pursue further specialization in selected fields, enabling them to pursue careers where scientific knowledge is applied and translated into practical interventions, with the ultimate goal of improving respiratory health on a global scale.

COURSE: "Water Quality Control"

In this course, students will learn the fundamental principles of water treatment processes, including coagulation, sedimentation, disinfection, filtration, oxidation, membrane separation, adsorption, and ion exchange. The ultimate goal of this course is to assist students in developing analytical thinking skills and problem-solving abilities

in engineering, which are essential for addressing the increasingly complex challenges associated with water quality.

COURSE: " Air Pollution: Health Effects and Air Quality "

Exposure to atmospheric pollution is the leading contributor to the global disease burden. This course will take an interdisciplinary approach to address the worsening of public health resulting from atmospheric pollution. Following an examination of the factors that determine air quality (e.g., sources, emissions, chemical transformations, and transport), pollution measurement techniques, and air quality management strategies, the course will discuss the impact of poor air quality on health. It will include the analysis of case studies and a research project focused on an air quality-related topic of interest.

COURSE: " Environmental Justice and Health Disparities"

Equality and justice are crucial aspects of environmental health issues. The main components of this course will encompass a historical overview of environmental justice movements, principles of environmental justice, methods for quantifying environmental health inequalities in research, climate justice and energy transitions, as well as an examination of the causes and consequences of the unequal distribution of both environmental risks and adverse health conditions among a broad spectrum of marginalized groups in the United States.

COURSE: "Environmental Law and Science Communication"

Environmental law can serve as the sole institution that stands between us and the depletion of our planet. It is also an institution that must consider and reconcile human freedom and economic ambitions. This course will explore these issues and examine and evaluate current approaches to pollution control and resource management, as well as emerging regulatory strategies, including economic incentives and voluntary emissions reductions.

COURSE: "Environmental Disasters: From Hurricanes to Wildfires"

This course focuses on the operational aspects of planning and responding to domestic and international public health and medical emergencies. The course places particular emphasis on domestic scenarios in the United States and familiarizes students with U.S. government guidance documents. However,

relevant international references and variations are included to highlight and explain specific concepts.

SEMESTER 3 - SEMESTER 4

During the 3rd and 4th semesters of the Program, students are required to complete a master's thesis. The Coordinating Committee (CC), upon receiving an application from the candidate that includes the proposed title of the thesis and the suggested supervisor, along with an abstract of the proposed work, appoints the thesis supervisor and forms the three-member examination committee for the approval of the thesis, with one of its members being the supervisor (Paragraph 4, Article 34, Law 4485/2017).

The supervisor of the master's thesis can be a faculty member, professor in the MSc program. The supervisor will monitor and advise the graduate student, being aware of the progress of their studies.

The members of the three-member examination committee can be faculty members (DEP) or laboratory teaching staff (EDIP), as well as Researchers of Research Institutions who have undertaken teaching duties in the MSc program.

The subject of the master's thesis must have a research character and demonstrate elements of originality.

Furthermore, there is the possibility of combining the ERASMUS program with participation in the MSc program.

The language used for writing the master's thesis is English, with an abstract (extended summary) in Greek.

The master's thesis is prepared in accordance with the guidelines provided on the website of the MSc program and the website of the Department of Chemistry (www.chem.uoa.gr).

To obtain approval for the thesis, the student must defend it before the examining committee (paragraph 4, article 34, Law 4485/2017). Theses are typically presented during the fourth semester, but those who have requested an extension can present until May 31st of the sixth semester. A successful thesis is one that receives a grade equal to or greater than five (5).

The Tripartite Examination Committee signs the relevant Minutes and submits them, along with the necessary supporting documents, to the Department's Secretariat for swearing-in, as outlined on the Department's website. If the tripartite examination committee deems the thesis unsatisfactory, they will provide the student with

recommendations for further modifications, improvements, and changes. The student may be invited for a repeat presentation during the next examination period.

Each student is required to maintain a research journal. This journal, along with any related primary data and materials (such as spectra, recordings, electronic files, etc.), belongs to the laboratory where the student conducts their research and remains there even after the student completes their studies.

The supervising professor is responsible for presenting the research results to external parties, such as publications in journals, conference presentations, reports to institutions, patent applications, etc. These presentations should adhere to international practices and scientific ethics.

The protection and exploitation of research results, including any potential economic aspects, are governed by the regulations of the University of Athens (NKUA) and the agreements the institution has with third parties.

The final grade for the MSc degree is calculated by summing the products of (credit units x course grade) and (credit units x thesis grade) and dividing it by the total number of credit units for courses and the thesis.

Upon approval by the examining committee, master's theses are mandatory uploaded on the website of the Department of Chemistry, including the title and abstract (article 34, paragraph 5, Law 4485/17).

Additionally, the electronic submission of the thesis is carried out in the Digital Repository "PERGAMOS," following the decisions of the University of Athens (NKUA) Senate.

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SPECIAL STUDY ISSUES

OBLIGATIONS AND RIGHTS OF POSTGRADUATE STUDENTS

1. Graduate students are entitled to all the rights and benefits granted to undergraduate students, with the exception of the provision of free textbooks. The institution is responsible for ensuring accessibility to the recommended textbooks and teaching materials for students with disabilities and/or special needs (paragraph 3, article 34, Law 4485/2017).
2. Graduate students are expected to actively participate in and attend seminars conducted by research groups, discussions on literature updates, laboratory visits, conferences/seminars related to the field of study of the Master's program, lectures, and other scientific events organized by the Master's program. The successful completion of the Master's program requires the physical presence of graduate students in all the scheduled obligations during working days and hours.
3. The Department of Chemistry Assembly, in collaboration and consultation with the Graduate Program Coordinating Committee, has the authority to decide on the expulsion of graduate students in the following cases:

- Exceeding the maximum allowed number of absences.
- Failing the examination of one or more courses (regular and retake) and not successfully completing the program.
- Going beyond the maximum duration of study specified in the current Regulations.
- Breaching the established regulations regarding the handling of disciplinary offenses by the appropriate disciplinary bodies.
- Voluntary request for expulsion by the graduate students themselves.
- Committing an offense that falls under the jurisdiction of the law (Student Disciplinary Law, article 24, Law 4777/2021).
- Failing to fulfill the required tuition fee payment.

TUITION FEES

For their participation in the MSc program "Environmental Sciences and Public Health," graduate students are required to pay tuition fees once the exemption process from tuition fees, for those eligible (Greek candidates), is completed, based on Law 4485/2017, article 35.

The tuition fees amount to:

- €6,000.00 in total for candidates within the EU.
- €10,000.00 in total for candidates from non-EU countries.

The tuition fees are paid in four installments as follows:

- The first installment, amounting to €1,500.00 (or €2,500.00 for non-EU candidates), is paid immediately after the final selection of graduate students and before enrollment at the Department of Chemistry's Secretariat.
- The second installment is due within the first two weeks of the second semester, amounting to €1,500.00 (or €2,500.00 for non-EU candidates).
- The third installment is due within the first two weeks of the third semester, amounting to €1,500.00 (or €2,500.00 for non-EU candidates).
- The fourth installment is due within the first two weeks of the fourth semester, amounting to €1,500.00 (or €2,500.00 for non-EU candidates).

The respective amounts should be deposited into the bank account of the ALPHA BANK, under the Special Research Account (ELKE) of the University of Athens (NKUA)(ΕΚΠΑ in Greek). Registration for the new semester cannot be completed without presenting the proof of payment.

APPLICATION FOR TUITION FEE EXEMPTION

Exempted from the tuition fees are students of the MSc whose individual income, if they have the same income, and the family's disposable equivalent income do not exceed independently, the individual one hundred percent (100%) and the family one seventy percent (70%) of the national median disposable equivalent income, according to the latest published data of the Hellenic Statistical Authority (EL.STAT.). This exemption is granted for participation in a single MSc. In any case, the number of exempted students shall not exceed thirty percent (30%) of the total number of students admitted to the MSc. If the beneficiaries exceed the percentage of the previous paragraph, they are selected in order of ranking starting from those with the lowest income (Article 35, paragraph 2, Law 4485/17).

SCHOLARSHIPS

In order to pursue their studies, students have the opportunity to receive scholarships. These scholarships are categorized as follows:

a) Merit-based scholarships, which are awarded to the top-performing students of the postgraduate program, based on their performance in the mandatory courses of the 1st and 2nd semester. The scholarship, in each case, covers the tuition fees for the next two semesters. The scholarship is granted at a rate of 7% of the total number of students in the 1st semester.

b) Reciprocal scholarships (Law 4009/2011, article 54, paragraph 2), with the obligation for students to provide part-time employment of up to forty (40) hours per month in services of the Institution. In this case, students are exempted from paying a portion of the tuition fees. The amount of exemption is calculated based on the actual working hours. The hourly remuneration is determined at the beginning of each year upon the recommendation of the Coordinating Committee and the decision of the Department's Assembly. This decision is communicated to the postgraduate students of the program.