20-05-2020

INTER-INSTITUTIONAL POSTGRADUATE PROGRAM:
"OCEANOGRAPHY AND MANAGEMENT OF THE MARINE ENVIRONMENT

Call for applications (2020-2021)

Applications for registration in the Inter-Institutional Postgraduate Course (IPGC) "Oceanography and Management of the Marine Environment" can be submitted for the academic year 2019-2020.

The IIPGC "Oceanography and Management of the Marine Environment" is organized by the Departments of Biology, Geology & Geoenvironment, Physics and Chemistry of the National and Kapodistrian University of Athens (NKUA) in collaboration with the Hellenic Centre for Marine Research (HCMR).

The purpose of the MSc and the incorporated courses with their short descriptions are presented in Annex I.

The IIPGC "Oceanography and Management of the Marine Environment" receives BSc holders from the Departments of Geology & Geoenvironment, Biology, Chemistry and Physics, as well as from Departments of Schools of Science, Environment, Agriculture, Engineering, and other pertinent scientific domains, from Universities recognized by Hellenic Hellenic National Academic Recognition Information Centre (DOATAP)

The minimum attendance at the IPGC for obtaining the Master's Degree **is 4 (four) academic semesters**, including the elaboration of the Master thesis.

Students who intend to complete their undergraduate studies during the examination session of September 2020 have the right to apply. In case accepted applicants will not graduate promptly, they will expel.

Postgraduate student available posts: **thirty (30).**

Tuition fees: **2400 Euro** for EU citizens and **4.800 Euro** for non EU citizens (paid in 4 six-month installments).

Applications dates: **from 1/6/2020 to 18/09/2020** (exempted the period 10-21/8/2020).

Address for applications to be posted: **Secretariat of the Department of Geology & Geoenvironment, Panepistimiopolis Ilisia TK** 15784; tel: +30 210 7274419; +30 210 7274064),

Candidates are invited to submit the following supporting necessary documentation:

1. Application form (free format)
2. Curriculum vitae
3. Certified copy of Bachelor's Degree or certificate for completing undergraduate studies, on which the exact degree should appear.
4. Publications in peer-reviewed journals, if any, or communications in national or international conferences
5. Evidence of professional or research activity, if available
6. Photocopy of both sides of identity card
7. Two (2) letters of recommendation
8. Certificate of language competence proving "very good" knowledge of the English language
9. Transcript of records

- Students from foreign institutions should submit a certification of parity and equivalence from Hellenic National Academic Recognition Information Centre (DOATAP)

Students selection is performed by the Steering Committee of the IPGC according to the following criteria;

- Bachelor's Degree grade
- Grade average in three (3) undergraduate courses, pertinent to the subject of the IPGC
- Performance in Thesis, as specified in undergraduate studies
- Certified knowledge of the English language
- Possession of second Bachelor's Degree
- Research activity
- Publications
- Recommendation letters
- Oral interview

Information: http://oceanography.geol.uoa.gr/

The President of the Inter-Institutional Steering Committee

Professor Serafeim Poulos

Annex I

PURPOSE

The purpose of the Inter-Institutional Postgraduate Course (IIPGC) "Oceanography and Management of the Marine Environment" is to provide high level postgraduate education in this scientific field.

The minimum study length in the IIPGC for the acquirement of the MSc Oceanography and Management of the Marine Environment Degree is set at 4 (four) academic semesters, including the necessary time to perform the diploma thesis. To acquire the MSc Degree, a total of one hundred and twenty (120) credits (ECTS) are required, following a distribution pattern of 30 ECTS per semester.

During this course, postgraduate students are required to attend and successfully undertake modules (assessed through written examinations, essays, laboratory exercises and oral presentations) conduct research work and write scientific papers, as well as perform a diploma thesis. Teaching incorporates live classes, lectures, scientific conferences and symposia, as well as practical training. In addition, during their studies, Postgraduate Students attend a series of Seminars and Lectures with no credits.

Postgraduate Students attend common compulsory modules during the first semester, whereas during the second semester they can select among the provided modules as many as necessary in order to gather 30 ECTS, whose content is related to the subject of the Diploma Thesis they wish to elaborate.

In the third semester, the Postgraduate Students attend the compulsory module Management of the Marine Environment and begin their Diploma Thesis. During the fourth semester, Postgraduate Students complete their Diploma Thesis.

COURSES

1st Semester

Introduction to Geological Oceanography

Basic principles of Physical Geography (lithospheric (tectonic) plates, origin and evolution of the oceans, orogenesis, earthquakes, volcanoes, rocks and minerals, geologic time scale) - Introduction to the ocean underwater exploration - Seabed relief - Marine sediments (particle size, composition, sources, deposition rates, global distribution) - Volcanism - Palaeogeography - Geotectonics and palaeogeographic evolution of the Eastern Mediterranean. Topographic maps and profiles - Digital terrain models-Morphological gradient maps-Geological maps and sections-Horizontal, tilted, fractured and folded rock strata-Lithostratigraphy and associated units - 3D models of tectonic structures.

Geographic Information Systems

Coordinate systems, map projections and geographic (datum) transformations - Digital databases/libraries - Subject areas - Primary and secondary data sources - Production of thematic maps - Mapping and statistical plots of the spatial variability and occurrence of a variety of parameters - Applications in Oceanography.

Introduction to Chemical Oceanography

The subject of Chemical Oceanography. Water balance on earth, hydrological cycle. Cchemical structure of water and the impact of pressure, temperature, electrolytes. Seawater and its physicochemical properties. The Ocean as a chemical system (redox, sorption and complexing

processes - balances), salinity. Speciation of seawater components. Dissolved gases (oxygen, nitrogen, carbon dioxide). Carbon, nitrogen, silicon, sulfur cycles in the sea. Photosynthesis. Dissolved and particulate organic matter. Trace elements (distribution, speciation). Chemistry of marine sediments. Introduction to marine pollution. Application of basic chemical laboratory techniques in Oceanography: titrations, spectrometry, chromatography et c. Basic techniques for water, sediment and biota sampling. *In situ* and laboratory measurements of basic parameters: salinity, pH, temperature, dissolved oxygen, BOD/COD.

Introduction to Physical Oceanography

DESCRIPTIVE PHYSICAL OCEANOGRAPHY: Physical properties of seawater (salinity, temperature, density, water masses). Observational methods and ocean simulation and forecasting (physical oceanography instruments, numerical modeling, basic concepts of operational oceanography). Surface and vertical distribution of the physical properties in the ocean.

DYNAMICAL PHYSICAL OCEANOGRAPHY: Momentum equation in the ocean (forces in ocean dynamics, the effect of the earth's rotation, basic scales in the marine dynamics). Conservation equation in the ocean (conservation of mass and other physical properties of seawater).Currents without friction (hydrostatic, geostrophic balances and the inertial motions).Shallow water equations. Currents in the presence of friction (wind-driven circulation, the Ekman and Sverdrup theories and the westward intensification). Thermohaline circulation (water mass formation and the overturning circulation).Gravity waves in the ocean. Waves affected by the earth's rotation. Tides (forces that induce tides, basic tidal characteristics and the effect of the oceanic topography).

Databases and statistical analysis

Descriptive statistics. Data tabulation. Statistical errors. Statistical description of random processes. Theoretical distributions and extreme values- Confidence intervals. Significance tests. Regression-Correlation. Factor Analysis.

Introduction to Biological Oceanography

Historical review. Marine environment division. Abiotic parameters. Biological interactions. Biodiversity. Food webs. Primary production. Plankton. Nekton. Benthos. Protected marine organisms. Invasive species in the Mediterranean Sea. Divisions, adaptations, migrations. Elements of Fishery Biology. Elements of Aquaculture.

2nd Semester (optional courses)

Plankton: Structure, Function, Ecology

PHYTOPLANKTON: Ecological characteristics of the pelagic zone. Phytoplanktonic organisms: Main taxonomic groups of phytoplankton. Systematic features, ecology, cellular structures and reproduction of the main groups. Taxonomic classification, phylogenetic relationships and economic importance of organisms. ZOOPLANKTON: Holoplanktonic and meroplanktonic organisms. Main taxonomic groups of zooplankton (identification keys). Sampling methods. Study of planktonic samples. Rearing protocols.

Benthos: Structure, Function, Ecology

PHYTOBENTHOS: Introduction: Classification of coastal zones and their vegetation. Types of substrates. Main ecological characteristics of coastal ecotypes. Benthic microalgae, Benthic macroalgae, Spermatophyta: Taxonomic traits, ecology, cellular structures and reproduction of the main taxonomic groups. Systematic classification, phylogenetic relationships and economic significance of organisms. ZOOBENTHOS: Introduction. Benthic biodiversity. Functional types of benthic organisms. Substrate-organism relationships. Factors that determine the species

distribution and biocommunities composition. Diversity, Stability. Impact of pollution on benthic communities.

Necton: Structure, Function, Ecology

SYNTHESIS OF NEKTON: Diversity and Zoogeography. FISH: Anatomy, physiology and adaptations to the marine environment. Age, growth, reproduction and biological cycles of the major taxonomic groups. Behavior. MAMMALS: Anatomy, physiology and adaptations to the marine environment. Age, growth, reproduction and biological cycles of the major taxonomic groups. Behavior. NEKTON ECOLOGY: Feeding ecology and food webs. Impact of pollution on the necton organisms.

Bioindicators - Ecological Water Quality.

Definition of the Ecological Quality of Water systems and Biological Data for the Ecological Quality Assessment. Typology, reference conditions and classification of the Ecological Quality. Concepts of physical geography and ecology of water systems. The eco-region of the Mediterranean Sea. Types of water bodies in coastal, transitional, flowing and lake waters. Heavily modified water systems. Adaptations of aquatic organisms in the abiotic environment. Competition. Species as indicators of environmental disturbance. Biocommumity Dynamic. Biological indicators for the measurement of Ecological Quality. Indicators based on the biological elements "zoobenthos", "phytobenthos", "phytoplankton", " ichthyofauna ".

Fisheries and Stock Assessment

The global fisheries production. Fisheries exploitation standards. Fishing gear and technology. Fishing effort and methods of calculating the effort. Distribution, Abundance and Population Characteristics of the most important commercial species of Osteichthyes, Chondrichthyes, Mollusk and Crustacean in the Mediterranean Sea. Impact of fisheries on populations and bio-communities. By-catches and discards. Control and monitoring of fisheries and stocks. Methods of estimating stocks. Elaboration and analysis of research data. Fisheries management. Objectives, strategy, technical measures and actions.

Marine Microbiology

Morphology and functions of marine prokaryotic microorganisms (Bacteria, Cyanobacteria, Archaea). Metabolic diversity - intake of energy and nutrients, growth. Methods for studying the aquatic microorganisms. Measuring productivity - biomass. Biodiversity. Marine viruses. Structure and life cycles of the phaga. Diversity of “species”, abundance and biogeography. The fungi in marine environment. Ecology. The microbial trophic web of the water column. Photosynthetic microbial populations in plankton. Biogeography of aquatic microorganisms. Sediment geomicrobiology. Influence of bio-disturbance by the endofauna on the bacterial processes of transgenesis. The role of microorganisms in the sediment trophic webs.

Biodiversity estimation and conservation

Definition of biodiversity. Importance of measuring biodiversity. Types of biodiversity. Principles of sampling design. Formulation of the zero hypothesis. Sampling schedules in space and time. Selecting of samples and collection methods. Data types – Data transformations. Creating a database. Species-abundance distributions. Patterns of species abundance distribution. Statistical patterns of distribution. Biological patterns of distribution. Standards of Habitat/Resources Division. Parametric and non-parametric methods of estimating the species abundance. Indicators of species abundance. Curves of species accumulation. Taxonomic diversity. Functional diversity.

Methods of comparing biodiversity in space and time. Grouping methods. Sorting methods. Methods of linking biotic and abiotic data.

Sedimentary marine environments

Sedimentation and Carbon cycle, climate and sedimentation processes, denudation and sedimentation rates, tectonism and sedimentation, marine sedimentation mechanisms. Sea floor sediment sampling. Shallow and deep marine clastic, carbonate and evaporitic systems, restricted depositional environments. Basic marine sedimentary analytical methods. Principles of Sedimentary sequence development, correlation of seismic sequences with sedimentation systems. Seismic stratigraphy of marine depositional systems, seismic stratigraphy of clastic, carbonate and evaporitic systems. Mineral resources in marine sediments.

Coastal hydrodynamics, morphodynamics and sediment dynamics

Coastal relief, shoreline morphological characteristics and natural processes for the formation of coastal features, coastal hydrodynamics (waves, currents), fundamental principles of sediment dynamics, coastal sediment transport, coastal erosion, coastal vulnerability indices, introduction to coastal engineering and technical works, causes and effects of climate change.

Methods of seabottom exploration.

Underwater acoustics - Bathymetry methods and systems - Side scan sonar systems - Single channel reflection systems (high, medium and low frequencies), Multichannel reflection systems. Analysis and interpretationof seismic reflectors, seismic sequence identification and interpretation. Digitalacquisition and processing of seismic reflection data in various formats e.g. SEG-Y (Datasonics, Cheseapeake, CODA, SeiSeekαιKingdom).MarineGravity, Magnetic and Electric methods, other sea floor prospecting methods. Sea floor prospecting operational planning. Marine technical installations and sea floor research, sea floor instability and hazards.

Underwater morphology, volcanicity and geodynamics

Underwater geomorphology, volcanism and geodynamics. Methods of seafloor mapping, geomorphological underwater structures. submarine volcanoes and volcano-sediments, Passive and active continental margins, ocean basins, Orogenic Arcs, Fore arc basin, back arc basin, internal basins, interpretation of seismic profiles, morphotectonic analysis of offshore and onshore topography, tectonic grabens and horsts, uplift and subsidence of neotectonic blocks

Paleoceanography and Climatic change

Concepts of Paleoceanography-Paleoceanographic indicators. Climatic changes/cyclicity. Times of stratified conditions, increased productivity, green house effects in the paleo-ocean. Mediterranean Paleoceanography. Climatic variability and triggering factors. Proxy data and CO2 measuring techniques. Global climate change and major impacts-ocean acidification.

Dynamical Physical Oceanography

Geophysical Fluid Dynamics introductory concepts. The effect of the earth's rotation on the ocean circulation. The theory of wind-driven circulation. The effects of stratification on the ocean dynamics. Equatorial dynamics. The thermohaline circulation, water mass formation and the abyssal circulation.

Marine Meteorology and its interaction with the ocean

Forces in atmospheric dynamics and the atmospheric momentum equation. Geostrophic balance in the atmosphere and the thermal winds. Air-sea interaction. Formation and development of

fronts in the atmosphere. Storms and the synoptic scales. Elements of climatic variability (El Nino).Multiple equilibrium states of the marine atmospheric climate. Elements of the greenhouse theory and the role of the ocean. The marine atmospheric boundary layer. Basic physical characteristics of seawater and the typical stratification of the oceans. Elements of the basic laws in the oceanic dynamics. Laws of property transfer in the air-sea interface. The effect of surface waves in air-sea interactions. The Ekman layer and the mixed layer of the ocean. Deep convection and water mass formation. Interannual variability and the biogeochemical cycles

Marine optics

Light, radiometry - photometry. Introduction to optical oceanography, absorption, scattering and the inherent optical properties of seawater. Active optical constituents of the sea, transfer theory of radiation and its apparent optical seawater properties. Telescopic methods, sea color and atmospheric correction..

Introduction to Numerical Modeling in Oceanography

Introduction to discretization methods.Time schemes in numerical simulation. Multivariate equations. 3-D ocean models. Sub-grid scale parameterization. Ocean models and their applications.

Methods of data analysis

Computer lab. Time series analysis. Filters. Tests of statistical significance. Fourier analysis. Trend analysis. Principal component analysis. Canonical correlation analysis.

Marine pollution

Basic pollutant sources in the sea. Classification of marine pollution. Mechanisms of pollutants influx and circulation in the sea. Nutrients – eutrophication. Heavy metals (Hg, Pb, Cu, Zn, et c). Petrochemicals. Synthetic toxic organic compounds. PCBs. Pesticides. Organotin compounds. Nuclear isotopes. Litter. Secondary pollution. Impact, monitoring and elimination of marine pollution. Antipolluting technologies.

Analytical Chemical Oceanography

Analytical techniques in Chemical Oceanography. Precision – sensitivity of chemical analyses. Good laboratory practice, quality control of laboratory measurements. Determination of chemical oceanographic parameters in seawater, sediments, biota: organic carbon, nutrients, chlorophylls, trace elements, metals, petrochemicals, detergents, phenols, pesticides et c. Statistical treatment and presentation of results, charts, distributions.

Marine ecotoxicology

Principles of ecosystems functioning and structure. Health of ecosystems, ecological-environmental indices. Population ecology. Matter-energy flow charts. Principles of ecosystems analysis. Ecological research methods. Biological mechanisms of toxic, carcinogenic and dangerous chemicals action. Endocrine disruptors. Toxicity tests. Oxidative stress of organisms. Basic principles of ecology, environmental toxicology and ecotoxicology. Ecological risk assessment. Legal framework for protection from toxic substances. Ecotoxicological methodologies and environmental impact assessment. Demonstration of basic toxicological tests in aquatic organisms.

Specific chapters in chemical Oceanography

In situ experiments. Laboratory simulations (microcosms-macrocosms). Magnetic measurements. Surface film, Pore water. Radiodating. Speciation research in the sea. Sequential extraction of sediments. Bioaccumulation studies in higher organisms. Study of dissolved gases in the sea. Biomarcers-bioindicatros, surface film, pore water

Natural products from marine organisms and their use

Techniques for isolation and recognition of useful compounds from marine organisms. Examples of such compounds and their use. Metabolites in marine organisms and their possible uses. Drugs and cosmetics from marine organisms. Organic raw materials from the sea.

3rd Semester

Management of mariine Environment

Definition – necessity of environmental management – sustainable development. Management planning. Management techniques –perceptions – evolution of management definition. Management tools (institutional, technological, financial, social). Management of marine protected areas. Protection of endangered species. Minimum sustainable population. Integrated Coastal Zone Management. Sustainable management of wetlands and deltaic systems. National – European legislation for protection, management and exploitation of marine environment. International conventions. Marine Strategy Framework Directive, Marine Spatial Planning

Marine Resources: Sustainable Development (Principles-Strategy) in the management - exploitation of marine resources (mineral, chemical, fishing, etc. stocks). Salt production. Sea water-desalination. Energy from renewable marine sources. Seafloor minerals Submarine phosphorites. Magnesium and Iron tubers.

Operational Oceanography: "Introduction to Operational Oceanography: Technological component; prognostic constituent; applications in the Greek seas. "

Remote sensing applications in coastal zone management: Introduction to remote sensing applications in the environmental monitoring of coastal zones, coastline changes, depth extraction, marine surface fluctuations, fisheries, etc.

Diploma thesis (Undertaken, theoritical background)

4th Semester

Diploma thesis (experimental part – completion - presentation)