COURSE OUTLINE

1. GENERAL

SCHOOL	APPLIED BIOLOGY AND BIOTECHNOLOGY		
DEPARTMENT	BIOTECHNOLOGY		
STUDY LEVEL	*Undergraduate*		
COURSE CODE	**12**	**SEMESTER**	7th
COURSE TITLE	HYDROBIOLOGY – PLANKTOLOGY		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Theory	3	1,56
Laboratory practice	3	1,56
Individual study		2,88
TOTAL		**6,00**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background
PREREQUISITES	
LANGUAGE	Greek
IS THE COURSE OFFERED for ERASMUS STUDENTS?	YES (in English)
COURSE WEB PAGE	Theory https://mediasrv.aua.gr/eclass/courses/EZPY159/ Laboratory practice https://mediasrv.aua.gr/eclass/courses/EZPY167/

2. LEARNING OUTCOMES

Learning Outcomes

Upon the completion of the course, the students will have the ability to:

- Combine water physicochemical characteristics and geomorphological data of the area with the living organisms of the aquatic environment
- Assess physical and chemical factors, that control populations, communities and ecosystems in aquatic environment
- Combine abiotic and biotic parameters for the comprehension of the structure and the function of aquatic ecosystems
- Classify aquatic organisms according to their lifestyle and distribution to the aquatic environment
- Discriminate planktonic organisms and explain their interactions
- Qualitatively (basic taxonomic groups) and quantitatively assess phytoplankton and zooplankton samples and understand their importance for oceanographic, fisheries and environmental studies
- Discover applications of Hydrobiology to Aquaculture and Biotechnology

General Competences

- Search, analysis and synthesis of data and information, utilizing modern technologies
- Adaptation in various conditions and new technologies

- Decision-making
- Independent personality
- Teamwork skills
- Consideration for the natural environment
- Develop judgement and self-criticism
- Promotion of free, creational and inductive thought

3. COURSE CONTENT

Theory

Introduction to Marine Environment

- Physical and chemical properties of water. Seawater (composition, salinity, oxygen)
- Geography and geomorphology of the oceans, tectonic plates, biogeographic realms
- Seawater masses and circulation (waves, tidal phenomena, sea currents, Coriolis force, Ekman spiral, upwelling, eddies)
- Ecological principles. Ecological components. Trophic levels in aquatic ecosystems
- Biogeochemical cycles (carbon cycle, nitrogen cycle, phosphorus cycle)
- Biological structure of aquatic ecosystems (niche, habitat, biocommunity, species abundance and diversity), ecological regulation
- Larvae and their ecology. r and K reproductive strategies
- Comparison between terrestrial and aquatic ecosystems
- Major subdivisions of the ocean

Plankton

- Life in aquatic environment (plankton, benthos, nekton, neuston). Plankton and planktonic communities. Buoyancy control in aquatic vertebrates
- Phytoplankton (diatoms, flagellates etc)
- Zooplankton (copepods, etc)
- Primary production. Factors that affect primary productivity (light, nutrients, hydrology). Geographical differentiations of productivity. Thermocline
- The oceanic ecosystem: the classical model and the microbial loop
- Plankton migration. Temporal variation of phytoplankton

Nekton

- Oceanic nekton synthesis. Differences between plankton and nekton.
- Ecology and adaptations of nekton, with emphasis to marine mammals (motion, buoyancy, body shape, camouflage, echolocation, migration, reproduction etc.)
- Feeding ecology. Trophic webs. Ecological importance of marine mammals

Deep Sea

- Zonation, subdivisions, and environmental characteristics of deep sea
- Ecology and adaptations of the organisms in different zones (color, size, eyes, mouth, bioluminescence, etc)
- Ecology of the benthic communities in the deep sea (synthesis, structure, richness, diversity, life cycles)

Laboratory practice

1. Biology and morphology of aquatic prokaryotic organisms with photosynthetic or chemosynthetic activity, such as Bacteria (mainly thiobacteria) and Cyanobacteria.
2. The Kingdoms of Life and brief history of the different classifications. Characteristics of Protista (according to the classification of the 6 Kingdoms) and Chromista (according to the classification of the 7 Kingdoms). Morphological and biochemical differences between

the three Domains: Archaea, Bacteria and Eukarya. Primary and secondary endosymbiosis. The Phyla of Kingdom Chromista and their importance in the aquatic environment.

3. Morphology and biology of: 1) diatoms, chrysophytes, xanthophytes and phaeophytes (Superphylum Heterokonta, Infrakingdom Halvaria, Subkingdom Harosa, Kingdom Chromista) and 2) ciliates and dinoflagellates (Superphylum Alveolata, Infrakingdom Halvaria, Subkingdom Harosa, Kingdom Chromista)
4. Morphology and biology of: 1) cercozoans, foraminiferans and actinopods (Superphylum Alveolata, Infrakingdom Rhizaria, Subkingdom Harosa, Kingdom Chromista) and 2) coccolithophores and cryptophytes (Subkingdom Hacrobia, Kingdom Chromista).
5. Morphology and biology of aquatic Metazoa with representatives belonging to the Holoplankton: Cnidozoa (Scyphozoa, Cybozoa and Hydrozoa including Siphonophora), Polychaeta, Ctenophora, Mollusca (Pteropoda, Heteropoda), Chaetognatha, Crustacea (Ostracoda, Cladocera, Copepoda, Amphipoda, Euphausiacea, Mysidacea, Decapoda, Anostraca-*Artemia*), Chordata (Appendicularia, Pyrosomatidae, Doliolida, Salpida).
6. Morphology of biological stages of aquatic organisms belonging to the meroplankton: larvae of Mollusca, Annelida, Echinodermata and Crustacea, as well as ichthyoplankton (eggs, larvae and fry).
7. Morphology and biology of Chlorophyta and Rhodophyta (Kingdom Plantae).
8. Methods of collecting and studying phytoplanktic and zooplanktic organisms.
9. Separation of plankton according to size and its role in marine ecosystems.
10. Analysis of real CTD autograph data (CTD Conductivity, Temperature, Depth). Team work (4 students per group)

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>TEACHING METHOD</td><td>Physical (face to face)

On-line (when necessary)</td></tr>
<tr><td>USE OF INFORMATICS and COMMUNICATION TECHNOLOGIES</td><td>• PowerPoint slideshows and video projections during teaching
• Teaching activity support through e-class platform
• Contact with the students via e-mail and announcements in the platform e-student
• MS Teams (when necessary)</td></tr>
<tr><td>TEACHING ORGANISATION (Lectures, individual or group assignments, field trips, individual study et.c.)</td><td>
<table>
<tr><th>Activities</th><th>Workload per semester</th></tr>
<tr><td>Lectures</td><td>39h</td></tr>
<tr><td>Laboratory practice focusing on methodology implementation and case studies in small student groups</td><td>39h</td></tr>
<tr><td>Individual study</td><td>72h</td></tr>
<tr><td>Total contact hours and training
(25 hours of student work load per ECTS)</td><td>150h</td></tr>
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<tr><td>STUDENTS EVALUATION</td><td>I. Theory
(a) Optional attendance of Lectures by students (progress, assignments, etc.).</td></tr>
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	(b) Final written examination (100%) including short answer or multiple-choice questions. II. Laboratory practice (a) Mandatory monitoring of the laboratory exercises by the students, with attendance records (progress, assignments, exercises, etc.). (b) Assessment of skills in laboratory measurements/observations and written examination with short answer or multiple-choice questions. III. The evaluation language is Greek (for ERASMUS+ students the evaluation is in English). III. The evaluation criteria are communicated to the students.

5. RECOMMENDED LITERATURE

Recommended Literature for Theory:

(A) Related scientific journals - Publications:

- Marine Biology 6th Edition by Jeffrey Levinton
- Hydrobiology
- Hydrobiology
- Hydrobiological Journal
- International Review of Hydrobiology
- European Journal of Zoological Research
- Oceanography and Marine Biology
- Limnology and Oceanography
- Progress in Oceanography
- Journal of Experimental Biology
- Advances in Marine Biology

(B) Digital Educational Materials (e-class):

1. E. Miliou, 2022. Introduction to the Marine Environment (lecture presentation, ppt), Department of Animal Science, Agricultural University of Athens (AUA)
2. E. Miliou, 2022. Plankton and Planktonic communities (lecture presentation, ppt), Dep. Animal Science, AUA
3. E. Miliou, 2022. Oceanic Nekton (lecture presentation, ppt), Dep. of Animal Science, AUA
4. E. Miliou, 2022. Biology of the Deep Sea (lecture presentation, ppt), Dep. of Animal Science, AUA

(C) Recommended Textbooks (EVDOXOS):

1. MARINE BIOLOGY. Nybakken James. ION - STELLA; PARIKOU & SIA OE, Book Code in Evdoxos: 14619 (IN GREEK)
2. MARINE BIOLOGY. Peter Castro, Michael E. Huber. UTOPIA PUBLISHING, Book Code in Eudoxos: 102124728 (IN GREEK)
3. MARINE BIOLOGY. Levinton Jeffrey S.. BROKEN HILL PUBLISHERS LTD, Book Code in Eudoxos: 86055640 (IN GREEK)

Suggested Literature for the Laboratory practice:

(A) Related scientific journals - Publications:

G. Verriopoulos, 2015. Guide to the identification of zooplankton organisms. Department of Biology, National and Kapodistrian University of Athens

(B) Digital Educational Materials (e-class):

1. E. Miliou, 2022. Halvaria (lecture presentation, ppt), Department of Animal Science, AUA
2. E. Miliou, 2022. Rhizaria & Hacrobia (lecture presentation, ppt), Dep. of Animal Science, AUA
3. E. Miliou, 2022. Zooplankton – Metazoa (lecture presentation, ppt), Dep. of Animal Science, AUA
4. E. Miliou, 2022. Meroplankton (lecture presentation, ppt), Dep. of Animal Science, AUA
5. E. Miliou, 2022. Protista – Chromista (lecture presentation, ppt), Dep. of Animal Science, AUA
6. E. Miliou, 2022. Bacteria - Cyanobacteria (lecture presentation, ppt), Dep. of Animal Science, AUA
7. E. Miliou, 2022. Chlorophyta – Rhodophyta (lecture presentation, ppt), Dep. of Animal Science, AUA
8. M. E. Miliou, 2022. Plankton collection and study methods – Importance of plankton in aquaculture (lecture presentation, ppt), Dep. of Animal Science, AUA
9. E. Miliou, 2022. Separation of plankton according to size – Role in aquatic ecosystems (lecture presentation, ppt), Dep. of Animal Science, AUA